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ABSTRACT

A study was made of the comparative media effects upon teaching the component learning tasks of concept learning: classification, generalization, and application. The seven selected methods of presenting stimuli to the learners were: motion pictures with spoken verbal; motion pictures, silent; still pictures with spoken verbal; still pictures, silent; printed verbal and spoken verbal; printed verbal; and spoken verbal. Six hundred and seventeen fifth and sixth grade boys and girls were divided into three mental ability groups and then were randomly assigned to one of the seven presentation modes. The results of the experiment indicated that there was no presentation mode superiority across the three learning objectives; however, the print and spoken verbal modes produced significantly superior performance test scores among modes in the classification objective. This implied that when specific types of learning can be identified, particular presentation modes will produce superior learning effectiveness. The study also points out the need for learning objectives to make a media stimuli taxonomy useful to the design of instructional materials. (MF)

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COMPARATIVE EFFECTS OF SEVEN VERBAL-VISUAL PRESENTATION MODES UPON LEARNING TASKS

Josiah Johnson Russell IV

1970

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COMPARATIVE EFFECTS OF SEVEN VERBAL-VISUAL PRESENTATION MODES UPON LEARNING TASKS

A Dissertation
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the Faculty of the School of Education
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of the Requirements for the Degree
Doctor of Education

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by
Josiah Johnson Russell IV
June 1970

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This dissertation, written under the direction of the Chairman of the candidate's Guidance Committee and approved by all members of the Committee, has been presented to and accepted by the Faculty of the School of Education in partial fulfillment of the requirements for the degree of Doctor of Education.

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CHAPTER I

PROBLEM

Which media will facilitate specific types of learning? Specific media design characteristics or elements in preparing instructional materials have not been recognized as problems by most educational media producers. "An urgent need exists," according to Saettler (1968, p. 119), "for a taxonomy of instructional media which can provide a systematic approach to the selection and use of media for educational purposes." Therefore, the purpose of this study was to explore the comparative learning effects of seven visual-verbal presentation modes for enhancing the learning of classifications, generalizations, and the application of learning.[1]

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[1] This dissertation was a part of larger unpublished media experiment entitled: "A Study of Stimulus - Task Relationships in the Learning of Verbally and Visually Presented Cognitive Materials" conducted by Dr. William H. Allen, Director of Cinema Research, University of Southern California. Allen's research project contained five separate experiments, one experiment for each of five types of learning: identifications, comparisons, concepts, generalizations, and the application of learning. This dissertation reports only the experimental results of the latter three; however, it is noted that stimulus and test materials developed for the experiment were used throughout all five experiments of Allen's study.

The other two learning types, the making of identi-

Media Selection Problems

Producers of educational materials have created enormous quantities of books, charts, teaching machines, films and other instructional materials. The literature indicates an increasing utilization of these materials and implementation of many innovations for instruction such as computer assisted and programed instruction, instructional television, games, and simulations. Yet, educational research provides little guidance for the selection of these media in terms of specific learning tasks. While it is obvious that media can be effective in the communication process, a sound rationale for media design, selection and utilization needs to be formulated on the basis of a systematic analysis of learning objectives and learner characteristics.

"Media research has not provided the needed basis for matching media with objectives," according to Briggs (1967, p. 8). Studies reviewed by Travers (1967) indicate few experiments identified particular types of learning or the characteristics of the learners.

Past research has centered on evaluative comparisons between media such as television and programed instruction, but neglected learning objectives for instruc-

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fication and comparisons, were reported by William H. Daehling in an unpublished dissertation entitled "The Learning Effects of Seven Visual-Verbal Presentation Modes on Making Identifications and Comparisons."

tional materials. Allen (1965) stated the real educational need is the development of a media taxonomy to use in the development of effective teaching materials for specific learning tasks or objectives.

Briggs et al. (1967) provided an excellent summary for the accumulated media design research up to 1967:

> . . . current findings will be of very limited usefulness until media research systematically provides for the (a) explicit definition of learning tasks used, (b) careful identification of learning conditions required by these tasks, (c) judicious selection of media to be evaluated, and (d) thorough analysis of media-, learner-, and environment-related characteristics to determine the nature and extent of their influence on experimental results. (Briggs, 1967, p. 139)

The need for a media taxonomy was first recognized in the 1949 NSSE Yearbook, AV Materials of Instruction (Henry, 1950), and the same need has been continually stressed over the past several years in the literature by Saettler (1968); Allen (1969); Briggs et al. (1967); and Meredith (1965). Allen (1967) has proposed a tentative taxonomy of media in applying media to art education, but it is not specific enough to provide precise design strategies.

Allen and Cooney (1963), Gagné (1965), Glaser (1966), Taylor and Williams (1966), have conducted a number of experimental studies in an attempt to provide a taxonomy for media design. Briggs et al. (1967) attempted to match media with learning tasks or instructional objectives with varied results. Thus, the instructional technologist is not yet capable of developing a precise taxonomy or to state which objectives media can best accomplish.

Summary. Many researchers contend that instructional efficiency can be affected by the relationship between instructional presentation mode or method and specific characteristics of the learner for specific learning objectives. The literature cited reveals three areas of concern for media design research: (a) media characteristics in relation to learning; (b) the relationship of learning objectives and media; and (c) media effects and specific types of learner characteristics. These three problem areas were the exploratory concern of this study.

Problem Statement

The main objective of this study was the investigation of the comparative effectiveness of seven different instructional presentation modes when used for teaching three learning objectives. The three learning objectives investigated were classifying, generalizing, and applying of learning in a new stimulus situation. The comparisons were made in seven content areas, four in social studies and three in science. Therefore, three experiments were conducted to determine the comparative effectiveness of the seven verbal-visual presentation modes for each learning objective. The verbal-visual presentation modes were:

1. Motion picture with spoken verbal (MpS)
2. Motion picture silent (Mp)
3. Still pictures with spoken verbal (SpS)
4. Still pictures silent (Sp)
5. Printed verbal with spoken verbal (PrS)
6. Printed verbal (Pr)
7. Spoken verbal (S)

The main independent variable, presentation mode, was analyzed in relationship to the organismic variable, mental ability, as measured by standardized intelligence tests. Analysis of the two variables yielded knowledge of interactions which took place between the two independent variables.

Measures of the dependent variable, performance scores, were compiled from specially prepared objective tests.

The secondary objective was the determination of learning retention in the student population for each of the presentation modes. Analysis of the retention performance scores yielded relationships between retention and specific presentation mode.

The subjects used in the experiment were fifth and sixth grade students from Bellflower Unified School District, Bellflower, California.

Hypotheses

The main objective of this study was to determine the comparative effectiveness of seven visual-verbal modes in performing the learning tasks of classification, generalization, and application of learning. The research hypotheses were as follow:

Hypothesis One

The seven visual-verbal presentation modes produce significant differences in mean performance scores, summed across mental ability, for the population sampled for each content area and learning objective.

Hypothesis Two

The three levels of mental ability will produce significant differences in performance score means for each content area and learning objectives.

Hypothesis Three

The main effects of presentation mode and mental ability interact to produce significant differences on mean performance scores for each content area and learning objective.

Hypothesis Four

The seven visual-verbal presentation modes will produce similar significant differences in mean performance scores, summed across mental ability, for the population sampled in both posttest and retention test for each content area and learning objective.

Hypothesis Five

The single and multichannel presentation modes produce significant differences in mean performance scores summed across mental ability levels for the population sampled for each content area and learning objective.

Hypothesis Six

The seven visual-verbal presentation modes will produce significant differences in mean performance scores on the three levels of mental ability for each content area and learning objective.

Definitions of Terms and Symbols

For purposes of this study, the following terms and symbols are defined:

Content Area

Content area refers to the curriculum subject content areas of science and social studies. Specifically, it refers to the seven subject titles of the stimulus material:

"Floating Markets of Thailand"	(Thailand)
"Egyptian Village Irrigation"	(Irrigation)
"Transportation in India"	(India)
"Use of Labor in Eastern Europe"	(Labor)
"Heat Can Do Work"	(Heat)

"Salamanders"	(Salamanders)
"Dome and Volcanic Mountains"	(Mountains)

Presentation Mode

Presentation mode variable refers to the seven selected methods of presenting stimuli to the learners:

1. Motion pictures with spoken verbal (MpS)
2. Motion pictures - silent (Mp)
3. Still pictures with spoken verbal (SpS)
4. Still pictures - silent (Sp)
5. Printed verbal and spoken verbal (PrS)
6. Printed verbal (Pr)
7. Spoken verbal (S)

Mental Ability Variable

Mental ability (MA) refers to intelligence as measured by standardized tests. Three levels of mental ability were designated as high (H), medium (M), and low (L).

Learning Objective

The learning objective or task refers to the three selected specific behaviors required by the students: the making of classifications, generalizations, and applications.

Learning of classifications. The task of grouping together stimuli, given in the presentation mode, on the basis of a common feature or property of each; or the task of providing a description or concept label for a group of stimuli.

Learning of generalizations. The task of understanding the relationship among principles, rules, or conclusions from several concepts, ideas, or classifications.

Application of learning. The task of utilizing generalizations or classifications with a new but similar set of stimuli which have not played a part in the learning itself.

Media Taxonomy

Media taxonomy refers to a standard classification system to enable one to identify specific attributes of the media and their relationship to learning objectives and learner characteristics.

Single and Multichannel Presentation Mode

A media channel refers to a transmission method in which stimulus cues reach the learner. A multiple channel refers to two transmission channels, i.e., audio and visual channels used in combination to provide stimuli simultaneously to the learner.

Summary

Chapter II reviews the research and development literature concerning the elements of media taxonomies. The chapter also analyzed media presentation modes as they relate to learning objectives of classification, generalization, and application and to different learner characteristics.

Chapter III describes the experimental design, subjects and mental ability, presentation modes, development of presentation and test materials, instrumentation, field procedure, preparation of data, and the statistical analysis.

Chapter IV reports the results from the analysis of the data for each restated hypothesis. Results reported comparisons of presentation modes, mental ability levels, interactions, single and multichannel presentation modes for post and retention test performance mean scores on seven film content areas in three learning objectives.

Chapter V reviews and summarizes the study problem, conclusions of the literature review, experimental methodology and hypotheses. The conclusions from the data on the main variables and instructional objectives under investigation are also discussed. The implications, recommendations for further research and recommendations concerning the implementation of the results were discussed.

CHAPTER II

REVIEW OF THE LITERATURE

The objectives of this review were:

1. To review the research and development of the elements in a media taxonomy.

2. To analyze media presentation modes as they relate to the learning objectives of classification, generalization, and application, and to different learner characteristics.

Media Taxonomies

The research and development of a media taxonomy requires specific identification of media characteristics, types of learning tasks or objectives, and learner attributes. Research contributions for a taxonomy have produced numerous breakdowns or lists of learning types which often overlap the learning types used in other taxonomies. The lack of clarity in learning type definitions has resulted in conflicting evidence in the literature concerning which media facilitate specific learning objectives. As a result, a large share of the discussion and research criticism of the existing taxonomies has concerned learning types and media categories.

To date, the pioneering efforts to develop a taxonomy have also suffered from the lack of valid media characteristics, their relationship with learning objectives, and learner attributes. This lack of a theoretical base has made the evaluation of taxonomy utilization difficult and the relative value of media to accomplish specific learning tasks inconsistent (Edling, 1968).

Briggs et al. (1967) has contributed the most pertinent media design model to match media to instructional objectives. The main emphasis of his attempt is on the external events of instruction--those presentational stimuli which bring about or reinforce a response. In the Briggs study cited above the procedures for identifying appropriate media were as follows:

1. State objectives behaviorally.
2. Sequence the objectives in psychological order.
3. Identify type of learning.
4. Identify sequence of events for learning type.
5. Identify content for each objective.
6. Identify content to be dealt with for each objective.
7. Determine external conditions for type of learning and subject matter.
8. Determine what stimulus forms, including media could be used to provide the external condition.

9. Identify best medium for a reasonably sized unit of instruction.
10. Determine type of instructional method: group, individual, automated, teacher controlled.
11. Assign media in terms of trade-off between objectives and practical convenience.

Briggs' procedure was a media design model utilizing the types of learning identified by Gagné (1965) and Melton (1964). The eight types of learning were: signal, stimulus-response, chaining, verbal association, multiple-discrimination, concept, principle, and problem solving. Gagné also identifies eight functions of the instructional situation that must be performed by its components--presenting the stimulus, directing attention, providing a model of expected performances, furnishing external prompts, guiding thinking, inducing transfer, assessing attainments, and providing feedback.

However, the selection of media under Briggs' procedure, or matching media with Gagné's eight types of learning is still done on an intuitive basis. Gagné (1965), however, questions whether the media stimuli and student responses of Briggs' procedure for reproductive learning objectives are the same for the learning of concepts, principles, and problem solving.

The "reproductive" learning tasks Gagné defines were those tasks in which the learner was required to reproduce verbal, manual, pictorial reproductions. Whereas, "productive-constructive" tasks involve recognizing and understanding relationships among things, events or ideas; the making of rules; identifying principles pertaining to the functioning of different kinds of operations; giving of examples of concepts; utilizing stimuli different from those used in the learning situation.

Briggs et al. (1967) concurred with Gagné when he stated that the stimulus-response theory, upon which the media selection procedure was based, was not adequate for learning of productive or higher order learning tasks. Thus, it seems questionable whether Briggs' procedure is effective for media selection or utilization in the higher order learning tasks which were under investigation in this study.

Tosti and Ball (1968) criticized Briggs' procedure because they felt the media options were made without consideration of the presentation design. Tosti and Ball outlined a media selection procedure model of their own which was similar to Briggs'; however, media selection appeared to be based on the equipment's physical limitations. A similar media selection procedure by Parker and Downs (1961) identified six learning objectives for a limited taxonomy on the basis of five pieces of training equipment. The two studies above base characteristics of the media on the physical aspects of the presentation or the equipment rather than the media's perceptual of psychological attributes. However, the physical aspects of the equipment and their relation to instructional objectives were not under investigation in this study.

Allen (1967) proposed an exploratory taxonomy of six learning objectives: factual information; visual identifications; principles, concepts, and rules; procedures; perceptual motor acts; and developing desirable attitudes, opinions and motivations. Media types in Allen's taxonomy were rated high, medium and low in their ability to meet various learning objectives; however, the ratings of high, medium and low were too general to clearly differentiate media effects.

Summary. In order to establish the validity of any of the proposed taxonomies, there needs to be uniformity of media categories and learning types. The existing taxonomies suggest that several different approaches have been utilized to develop a taxonomy, but superiority for any specific taxonomy has not been established. The literature reports no successful utilization of a taxonomy for media selection in the school curriculum. The reason for this failure can be attributed to the lack of research on media characteristics and their relationships to learning objectives and learner characteristics.

Learning Objectives of the Study

In recent years, the effects of media usage to achieve specific learning behaviors have been under increased research attention; however, there still appears to be insufficient research evidence concerning media-learning task relationships upon which to make appropriate instructional media design decisions. The experimental studies which have attempted to establish characteristics of media-learning objectives relationsips have centered upon the teaching of "factual" material. Media research on the higher order learning objectives or tasks has been neglected.

In a number of media studies reviewed by Allen (1960) the term "factual" learning has not been defined inclusively and often varied to include: discrimination learning, the making of comparisons, recall, memorizing, recognition, and identification. However, these learning terms fit within the "reproductive" learning category defined by Gagné (1965). Included in the category were the tasks in which the learner was required to reproduce "verbal, manual or pictorial reproductions [May, 1965]."

Under investigation in this thesis, however, were the concept or "productive-constructive" tasks which were defined by Gagné (1965): tasks involving recognizing and understanding relationships among things, events or ideas; the making of rules; identifying principles pertaining to the functioning of different kinds of operations; giving of examples of concepts; utilizing concepts with stimuli different from those used in the learning situation.

Past media studies indicate that the definitions of concept learning are either too broad or too ambigious to relate with specific media effects; therefore, concept learning needs to be researched on the basis of its component tasks, i.e.: classification, generalization, and application.

There appeared to be reasonable consensus by media researchers on two points concerning concepts: the _definition_ of a concept and the _processes_ of concept learning (Bourne, 1966; Hunt, 1962; Gagné, 1965; Travers, 1967; DeCecco, 1968).

A concept exists whenever two or more distinguishable objects have been grouped or classified together and set apart from other objects on the basis of some common feature or property characteristic of each (Bourne, 1966). The process of concept learning involves: (1) classifying, grouping, or categorizing stimuli with respect to certain attributes and relationships into logical or functional groups, or to make a category response to each of a series of stimuli, or provide an explicit description or name for the group of stimuli, (2) generalizing--the relationships among classifications, ideas, principles, rules or laws, (3) application--by discovery and/or use of already discriminable and labeled classifications or generalizations solve a new problem situation without having to be prompted as to which abstraction is correct.

Therefore, for purposes of simplication in the discussion of presentation mode characteristics, the three learning objectives of classification, generalization, and application will be referred to as concept learning. Thus, the presentation modes will be analyzed in relation to concept learning and mental ability.

Summary. Concept learning has been identified in a number of media classification systems. However, until component elements of concept learning are utilized in a media taxonomy, specific media-learning tasks relationships are not likely to occur. The intent in this study is to study comparative media effects upon teaching the component learning tasks of concept learning: classification, generalization, and application.

Learner Characteristics

Several media research summaries indicate that relationships among various learner characteristics and specific media design factors have been almost entirely neglected by the experimental research.

> The importance of the characteristics of the learner upon the reception of instructional communications cannot be overemphasized. The earlier concept of the audience as a kind of atomistic mass, subject

> to persuasion or instruction by powerful communication medium, is being viewed with increased skepticism. (Allen, 1960, p. 122)

Only a small number of media studies, discussed in the presentation mode section of the review, have centered on the relationships of mental ability to learning from different kinds of instructional media (Hoban & van Ormer, 1950; Reid & MacLennan, 1967; Allen, 1960; Wendt, 1962; Briggs, 1968(b)). Cronbach (1967) hypothesized that a person's learning rate will vary, depending on the nature of the instruction and intelligence; therefore, adapting instructional methods will, in the long run, be more important than merely altering the duration of the exposure. He proposed that media research should deal with treatments and persons simultaneously, fitting groups of students with particular aptitude patterns. Hilgard (1965) reflected that media research had contributed little, if any, theory to more effective teaching. However, he postulated that the reason for this lack of media design guidance was that researchers failed to understand the subtle differences made by the kind of student, kind of teaching setting, and kind of long-range goals that are operative.

Gagné (1964) has suggested that individual aptitudes must be ranked among the most important independent variables in the study of complex learning. A prominent group of media researchers, as reported by Meierhenry (1962), have provided media recommendations for administrators and teachers which support the above finding of Gagné and the needed research concerns suggested by Cronbach (1967), Hilgard (1965), Snow and Salomon (1968) and also Glaser (1966), Taylor and Williams (1966), Briggs et al. (1967), and Hovland, Lumsdaine, and Sheffield (1949).

The focal point of the recommendations was the importance of needed research of learner characteristics and the interactions among them.

> Certain basic characteristics of the learner may not necessarily influence results of audiovisual instruction. Some, however, are patently significant for media researchers as they seek to find out what differential results growing out of the use of media depend upon differences in learners. Topics of profitable study for these researchers include: Such aptitudes or capacities for learning as (a) audio *vs.* visual *vs.* verbal *vs* tactile *vs.* affective aptitudes; (b) individual interests. Such variables as (a) the grouping of learners by ability (gifted, average, slow, homogeneous, heterogeneous, etc. . . . (Meierhenry, 1962, p. 308)

Presentation Mode Characteristics

The objective of this section of the review is to identify the characteristics of the presentation modes under investigation; therefore, the attributes of the motion picture, still picture, audio, and print in single channel presentations, and any two combinations of the above modes, referred to as multi-channel presentation, will be analyzed in relation to concept learning objectives and mental ability. The specific learning objectives are classification, generalization, and application.

Motion Picture Characteristics

Numerous studies have analyzed the effects of motion pictures, but they uniformly neglected to consider the elements of visuals which produce the effects. Characteristics of motion pictures were identified by Allen (1964) as follows: (1) reproduces or duplicates the real object or event, (2) produces two dimensional from three dimensional object or event, (3) utilizes events in natural motion, slow motion, time-lapse, or stop motion, (4) reduces or enlarges the real object or event, (5) uses black and white or color, (6) may be accompanied by narration, live synchronous sound, or sound effects, or may be presented without sound, (7) pacing of the presentation relatively flexible.

The application of these motion picture characteristics in an instructional presentation has direct implications for concept learning. Allen, cited above, outlined the following visual elements that facilitate concept learning: The use of visual examples and specific cues within the visual reinforce learning of verbal concepts; visual material has the ability to be more concrete, specific and structured than the non-concrete and more generalized nature of verbal, audio, and print presentation modes.

Gropper (1963,1966) contended that visual examples and cues facilitate acquisition, retention, and transfer of concepts. Presenting several visual examples which illustrate the same idea or principle provides greater possibilities for generalizing and transferring of learning to a new situation.

Allen (1964) and Gropper (1963) both indicated that the capacity or "information-loaded" nature of a visual provides the learner the opportunity to discover relationships among elements of the stimuli. The simultaneous and non-linear presentation property of several stimuli within a visual, facilitates the learner in searching out, comparing, and organizing cues into related groups. Specific elements within the visual can also be directed to the attention of the learner.

The combined efforts of Hsia (1968) and McCormick (1958) produced a list of general characteristics of visual modes based on physical properties and related with characteristics of the learner.

1. Spatial in nature, excepting TV and motion pictures which are also temporal.
2. Both sequential and simultaneous presentation.
3. Good referability; information can be stored in the display, but TV and motion pictures have poor referability in a normal communication situation.
4. Numerous dimensions in information coding.
5. Restricted flexibility and advance coding.
6. Much faster rate of transmission.
7. Greater versatility.

8. Less attention-demanding.
9. Less resistant to fatigue. (Hsia, 1968, p. 247)

May (1965) in a working paper explained the roles of visuals and verbals in motivating, cueing, and reinforcing acquisitions of responses for productive-constructive learning. May explained that visuals can facilitate productive-constructive learning as defined by Gagné (1965) and cited earlier in this chapter. They can do this by directing attention to key features, or a combination of features so that relationships may be formulated to produce a rule or concept. May's theory postulated that visualization of abstract concepts depends mainly on the extent to which patterns of stimuli are brought about in an image. This ability to bring together all relevant cues for a concept into a visual is unique to the visual mode. However, the exact degree of visual effectiveness for concept learning depends upon the learners' past experiences in forming association between objects, places, events, and relationships. This point suggests that learning effectiveness from visuals will vary among mental ability levels of learners.

Two studies related to the learning of concepts were reported in a comprehensive summary of media research (Allen, 1960). Rulon (1933) compared the learning effectiveness of eight films in general science. Eighth grade students were required to apply a concept or to infer relationships from one fact to another. Rulon found that when textbooks were supplemented with film, concept learning items were learned significantly better than rote items as measured by an immediate learning test and a retention test. Vernon (1946) found motion pictures produced greater gains than filmstrips on "comprehensive" items of a performance test. There were no differences between learning effectiveness of motion picture and still picture modes on "recognition" items. The film and filmstrips in the study were used to teach British seamen to take soundings with a lead line and a Kelvin sounding machine.

VanderMeer (1965) studied the comparative learning effects of eight films in the training of lathe operators. The findings of his study pertain to perceptual-motor skills; however, he concluded that films are probably more effective for teaching more complex learning skills than for teaching simple learning tasks.

Motion as an element of motion pictures has received very little research attention, and, as a result, the particular conditions under which the depiction of motion facilitates specific learning types are not known. Dale (1954) claimed that motion pictures can effectively convey concepts when motion is involved in the learning. However, he provided little evidence as to the aspects of motion which may cause this phenomena.

Vetter (1959), as a result of dividing the motion element into two factors, camera motion and motion within the image frame, indicated that motion develops spatial relationships, facilitates perceiving realism, produces knowledge of actions, and facilitates perceiving of velocity. Vetter's conclusions were reached by using a panel of teachers to make subjective judgments of the motion-relevancy factors in three elementary and three secondary science and social studies films.

Although a number of studies reported by Allen (1960) showed, in general, that motion pictures were almost equally effective as still pictures in teaching factual information, there is limited evidence to indicate whether the motion element of the content was evaluated in the comparisons.

In another experimental study, a motion picture visual treatment was found to be superior in learning concepts involving motion over still picture treatments. The reasons, however, for the superiority were not determined (Allen & Weintraub, 1968). The purpose of the experiment was to determine the comparative effectiveness of three presentation modes--motion pictures, sequenced still pictures simulating movement, and single still pictures showing principal points of the action. The main variables were the presentation modes, instructional objectives of concept learning and serial ordering, and the characteristics of the learner. There were no differences in the learning effectiveness of the still presentation modes.

Several media studies have established that motion picture and media-learner characteristic relationships do exist; however, a firm theoretical basis has not been formulated to provide a media-learner design taxonomy. In a number of studies, reported by Allen (1960);

> . . . persons of high IQ usually learn more from films than those of medium or low IQ. However, in some cases those of lower intelligence appear to make a greater gain in learning, but not enough to surpass the learning of the average or superior students. (Allen, 1960, p. 123)

Hoban and van Ormer (1950) in a comprehensive report of media research undertaken during the 1918-1950 period have summarized findings which suggest that learning from films is dependent upon learner's intelligence, training, or previous knowledge of the subject. The relationships between mental age and mode of presentation were found to be significant; the higher ability subject gained more from the verbal presentation whereas the lower ability subject gains more from the visual presentation.

Meierhenry (1952) believed the evidence for the superiority of films for low IQ students is not warranted. His evidence was based on the experimental research as reported and investigated by Smith (1949). Meierhenry's analysis suggested a contradiction to the Hoban and van Ormer studies cited above; however, the evidence in both studies does support differential learning effects for various mental abilities from motion pictures.

Allen, Cooney and Weintraub (1968) conducted a study comparing the learning effectiveness from motion and still picture presentations with five different types of audio narrations. No significant differences in criterion achievement were found between motion and still presentation for either high or low non-language ability or between high and low vocabulary ability groups.

During the past few years there has been an increase in interest by psychologists and instructional technologists in the interaction between learners and materials. In a research paper concerned with the nature of human aptitude and its relevance to media design of film and television, Snow and Salomon (1968) concluded that film and television attributes are likely to interact with aptitudes. These conclusions were drawn from a number of studies, only one of which was relevant to concept learning and mental ability factors. In the study, Hovland, Lumsdaine, and Sheffield (1949) found motion pictures in visual transformation of contour lines in map reading instruction more helpful for low ability students. Students with highly developed visualization ability did not need the filmatic presentation. They concluded that in general, learner aptitudes involved in receiving, organizing, coding, manipulating, storing, and retrieving visual images should be facilitated by the motion picture channel.

Hoban and van Ormer (1950) concluded from their review of numerous film studies that students with previous learning experiences such as transfer of learning sets and information processing strategies are likely to profit from film learning the greatest. Snow and Salomon (1968) indicated a high correlation between mental ability and the tasks Hoban and van Ormer list. From their findings came the suggestion for further research on specific description of student population in aptitudinal terms and tailoring of program presentations to yield improved research results.

Allen, Filep and Cooney (1967) in an experiment using Guilford's (1967) structure-of-intellect model and select measures of "figural" ability found no apparent relationship between the subjects' "figural" aptitude and the learning of the content. The design utilized different kinds of visual, audio, structural, or content inherency characteristics.

Allen and Daehling (1968) found no significant relationships between the Guilford structure-of-intellect factors and the mode of visual presentation when using still pictorial material. The purpose of their study was to determine the interrelationships among forms of visual presentation, content of the instructional material, and characteristics of learners. Neither the structure-of-intellect factors, sex, mental ability level, nor the language ability factors of the subjects showed significant relationships to the mode of visual presentation.

Summary. Several elements of motion picture mode have been identified and investigated. With exception of the motion element, specific characteristics of motion picture elements provided only general characteristics categories. The studies do suggest that certain elements of motion pictures can affect different learning behaviors if learning tasks and learner attributes are specified.

There appears to be some agreement that visuals can enhance learning effectiveness for concept learning by their unique ability to provide simultaneous presentation of many stimuli cues. This theory has only limited support by the research. Because concept learning gained from visual presentation appears to be closely related to the learner's ability to form relationships and associations among stimuli, learning expectations should vary among student mental ability levels.

Still Picture Characteristics

Two types of research on still pictures have been conducted in the past: comparison of still picture modes and other media and the elements of still picture production. The comparative studies do not identify visual elements which cause effects and therefore are of doubtful value in identifying still picture characteristics. Motion picture visual characteristics, described in detail in the previous section, will not be repeated in this section. Several studies which compare motion picture and still pictures for concept learning tasks were also reviewed in the previous section.

Allen (1964) suggested that still picture presentation characteristics are considered to be similar to motion picture with the exception of "motion" and "flexibility."

Spaulding (1956) investigated the effectiveness of still pictures with captions and found these types of pictures facilitated the learning of information difficult to present visually. Specific stimuli in visuals were pointed out by the addition of the captions. This finding suggests that for concept learning audio reference to visual stimuli or captions in the visuals will enhance the learning from the image.

Allen and Cooney (1963) conducted an exploratory study that used the film medium to examine the relative effects on learning of visual images presented non-linearly or simultaneously and visual images presented linearly or sequentially. Several learner variables, including mental ability, were considered and the results indicated that although significance was not reached, a difference existed between the non-linear and linear formats for sixth grade groups. The non-linear format was favored in both immediate and delayed tests. The results also cast doubt on the traditional beliefs of media-message design in terms of retention, method of presentation, format of presentation and types of learning, and presentation and age of learner.

Long and Welch (1942) used both photographs and words, differing in level of abstraction, to study effects of children's ability to generalize known principles. The researchers concluded that increasing the abstractness of the visual either by varying the medium of presentation or by varying the number of cues with the visual will affect adversely the child's ability to apply a principle of reasoning.

Gibson (1950,1954) identified two variables which are to be considered in the production of still pictures. Gibson stated that the degree of realism in the image is directly related to the degree of perception from the visual. The conclusion which can be drawn from this work concerning concept learning tasks is that realistic images are to be used for lower order learning tasks and words; symbols are to be used for higher order learning tasks.

Knowlton (1966) developed a visual taxonomy based on the visual-iconic signs of pictures independent of their physical attributes. Three elements for the taxonomy were identified: order of connection, patterns of arrangement, and elements. "Elements" would refer to the objects in the visuals, "pattern" to the spatial relation of the objects, and "order of connection" to the sequencing of the objects. The conclusions which can be drawn from his work are similar in one respect to Gibson's work which suggests there is a continuum from the realistic to abstraction within pictures; however, Knowlton does not relate the continuum to concept learning tasks.

Summary. There appears to be very little reference in the literature to the characteristics of still pictures which bring about or facilitate concept learning. The characteristics of visuals in general which accomplish concept learning tasks center around the visuals' ability to present numerous stimuli simultaneously, thus allowing a learner to scan the visual to form relationships among the elements.

Audio Characteristics

The research literature discloses no significant findings related to audio characteristics. The work of Allen (1964) and Hsia (1968), previously cited, listed visual and audio characteristics and showed similarity. The visual characteristics outlined by Hsia are cited in the visual characteristic section of the review. He characterized the auditory channel as:

1. Temporal in nature.
2. Sequential presentation.
3. Poor referability.
4. Fewer dimensions in information coding.

5. Greater flexibility; variation in connotations, nuances, and inflection.
6. Rate of transmission limited to speaking rate.
7. Less versatility.
8. More attention-demanding.
9. More resistant to fatigue. (Hsia, 1968, p. 247)

Physical characteristics of the audio channel as cited above, "poor referability" and "more attention-demanding" do not identify the learning conditions under which an audio presentation would be used and are of little value in optimum selection for effective learning. Allen (1964) outlined the unique characteristics of audio which are its abilities to reproduce real sound, timbre, intonation, sequential linear quality, single dimension, and inflexible pacing. These factors were the impetus for the language laboratory concept of instruction in foreign languages. However, language laboratory research has centered upon comparative instructional methods and neglected identification of audio characteristics.

Allen, Cooney, and Weintraub (1968) compared the effectiveness of five different audio narration implementation methods for accompanying visual material. Learning effectiveness comparisons were made between motion pictures and still pictures using varying audio narration styles for students of different mental abilities and vocabulary achievement characteristics. There were no significant differences found among the different audio methods for the total population. However, students with lower mental ability performed poorest on audio treatments that "posed" questions and presented the audio stimuli in a non-linear way. This finding does not confirm differential audio learning effectiveness for certain mental ability levels, but rather that learners expect a linear pattern to an audio presentation. When the non-linear audio is used less learning will result for low mental ability levels.

The compression or manipulation of audio presentations has been extensively reviewed by Travers (1967); however, it will not be included here because it has little relevance to concept learning.

Summary. There appear to be no audio characteristics identified in relation to concept learning or learning characteristics. This is the same conclusion Saettler (1968) reached after review of several studies; he stated the critical need for investigation of audio characteristics in relation to specific learner attributes and learning objectives.

Print Characteristics

Although print presentations in book form have existed for many years, the research has not identified many unique print characteristics. For learners who can read, few positive print superiority generalizations can be made over pictures, sounds, or spoken words. Briggs (1968), in a review of several studies, concluded that visual stimuli were best for difficult material. This visual material included spoken and printed words, but the conclusions are too general for print presentation mode as an optimum instructional selection over other mode options.

The data regarding the efficiency of auditory and print material, in an experimental study, have pointed to an interaction of modality with other factors--mental ability, reading ability, age, and difficulty of the material (Cooper & Gaith, 1967).

The physical characteristics of print (linear, sequential, and easy referability) have received limited investigation. Allen, Filep and Cooney (1967) used projected printed material in a programed instruction research project, comparing visual modes of presentation with different types of subject content. They concluded that subject matter having a concrete referent could be improved for learning effectiveness by adding still or motion picture to a printed treatment.

Research resulting from the programed instruction movement indicates several factors significant to the print-learner characteristics relationship. The basic assumption that programed instruction might be more effective for low ability students, prompted much of the programed instruction research.

Porter (1961), studying IQ differences in relation to effective methods of instruction in spelling, found that in the second and sixth grades especially the greatest gains for all IQ-method combinations were made by low IQ students who were taught by programed instruction.

McNeal (1962) also found programed instruction, when used in teaching reading skills to elementary children, to be very effective for low IQ children. Campbell (1962) reported that a branching-programed methods resulted in significantly better performance than a linear format for students in the upper IQ level as measured by the Differential Aptitude Test. The branching and linear programs, however, worked equally well for low ability students.

In a study by Jensen (1963) retarded, average, and gifted junior high school students were assessed for learning ability through the programed instruction mode. Variability of learning ability was much greater among the retarded students who showed much greater improvement with practice on successive tests of learning identifications. Some of these retarded subjects learned as fast as the gifted.

The programed instruction literature has not indicated which ability group profits most from printed programed instruction, but has suggested that programs can be used successfully with low ability groups for simple order learning tasks.

Dawson (1964) suggested that individuals differ in ability to recognize and to learn from certain graphic representation. Students who scored high on figural portions of the Guilford-Zimmerman Aptitudes Survey also were more successful in recognizing figural configurations than those who scored low on the Survey. However, individual aptitudes of eighth graders in learning from visual and verbal presentations were studied by Gagné and Gropper (1964), and no significant correlations between spatial aptitude and learning from pictorial representation were found.

The programed instruction research is mostly of the comparative nature--comparing conventional teaching with programed instruction. The programed instruction research was not designed to identify print characteristics. The difference in learning effectiveness from programed instruction is attributed to reading ability which is highly correlated with mental ability. Neither does programed instruction research identify the types of learning involved in the programs, thus it is difficult to make any generalization from the research in regard to concept learning. Programed instruction research does indicate a wide range of learning effectiveness for various learner characteristics. The reason for the differences in learning are attributed to motivation, reading ability, and other factors not related to the characteristics of the media used in the presentation of the programs.

Summary. The research indicates that unique print characteristics, with exception of those of a physical nature, have not been identified nor has there been a concentrated research effort in this direction. What does appear from the limited research finding is the need for identifying print characteristics in relation to specific learner characteristics and learning tasks.

Single and Multi-channel Characteristics

The literature concerning single and multi-channel presentation characteristics is very limited and provides no clues as to the learning effectiveness for concept learning.

Several researchers have postulated the idea that a saturation of cues in more than one transmission channel would be more effective in teaching than a single channel.

Travers (1966) cast doubt on this multi-channel superiority theory on the basis of several experiments using combinations of audio tapes and still pictures with redundant material in two channels.

Much controversy surrounds Travers' work on the basis of the relevancy of the content used in his testing material. The learning of nonsense syllables has little meaning in the school situation and thus his generalizations are of little value. Nevertheless, Travers has found no evidence for a multi-channel presentation superiority when presenting redundant material in two channels. However, when relevant cues or different information is presented in two channels, it produces significantly better recognition learning than one channel.

Conway (1967) also criticized Travers on the question of relevance. Conway suggested that, if coded messages and required responses were the same in two channels, there was no reason to expect increased learning from two rather than one channel presentation. Conway found superiority for multi-channel presentation for relevant cues.

Hartman (1961a) in a single-multichannel presentation experiment concluded that simultaneous presentation of an audio-print mode versus an audio mode or print mode for redundant material was superior. In further multichannel research Hartman (1961b) (a) claimed that relationships between channels must be specified for increased learning; (b) under channel interference conditions between pictorial and verbal information, the difficult content cues are least affected.

Severin (1967), however, found in an experimental study that audio-print mode was not superior to print alone, but better than audio alone. Audio with pictures was better than audio with print for word recognition. Thus, Severin suggests a contradiction to the cue summation theory of Travers.

Hsia (1968) claimed a superiority for multi-channel modes when the conditions of processing information are specified. This conclusion was drawn from a generalization learning experiment comparing audio, print, and pictorial channels and a combination of these channels. The assumption of the experiment was that a generalization between two stimuli is a function of the number of cues which the stimuli possess in common. As the number of identical cues associated with the two stimuli is increased, the probability that a response associated with one stimulus will be elicited by the other increases.

The difficulties encountered in extending the stimulus generalization theory to multi-channel findings are factors of channel interference in the attention to the stimulus information, or interferences produced by the meaning of the information itself.

The following conclusions are drawn on the presentation modes in this study on the basis of the single and multi-channel literature for concept learning:

Motion picture with spoken verbal should produce superiority over single channel modes for concept learning objectives on the basis of more cues upon which to base the generalization. Similar conclusions can be made for the still picture with a sound mode.

Print channel would be more efficient than the audio channel when the information to be presented is difficult or complex. The Print with spoken verbal would be least effective because the redundant material in each channel would interfere for all three learning tasks.

When comparing the learning efficiency of the single and multi-channel presentation modes of this study, the literature suggests no difference in learning effectiveness because the multi-channel modes carry simultaneous redundant material. However, the audio narration used in the multi-channel mode may draw reference to specifics of the visual in which case there would be an advantage for the multi-channel mode over single channel. This point suggests no conclusion can be drawn for single or multi-channel efficiency.

Summary. With the exception of the greater generalization capability of a multi-channel mode, there are no studies which examine single and multi-channel characteristics in relation to concept learning and learner characteristics. A basic assumption of multi-channel presentation, although there was no evidence for support, was the theory that multi-channel modes are superior to single channel modes for a wider range of learner mental abilities. This conclusion was based upon the idea that low ability learners gain best from visual presentation while high ability learners did better from print and audio presentation. A multi-channel presentation would allow both high and low ability groups to be presented stimuli simultaneously.

The validity of this conclusion has not been supported by the research.

CHAPTER III

METHODOLOGY

The experiment was designed to collect data on the comparative effectiveness of seven verbal-visual presentation modes when used for teaching three cognitive learning objectives. This chapter describes the experimental design, subjects and mental ability, presentation modes, development of presentation and test materials, instrumentation, field procedure, preparation of data, and the statistical analysis.

Experimental Design

The design required development of seven different verbal-visual presentation modes for each of seven different social studies or science films, or a total of 49 different treatments of the stimulus material. The administration of these presentation modes under controlled conditions yielded comparative data on the students from a post-test given immediately following exposure to the stimulus material and a retention test two weeks later.

Comparisons of the performance data were made for single and multiple channel modes, three mental ability levels, and seven verbal-visual presentation modes for each of three learning objectives: classification, generalization and application.

To minimize the effects of individual differences, a randomized 3 x 7 analysis of variance design was used with approximately four or more replications per cell. The arrangement of the variables in each learning objective is shown in Figure 1.

Presentation Modes

Mental Ability	(MpS)	(Mp)	(SpS)	(Sp)	(PrS)	(P)	(S)
High							
Medium							
Low							

Fig. 1. Experimental design

A posttest design was used without a control group because the hypotheses of the experiment were concerned with differential effects and not with whether or not the treatments produced more learning than none at all.

Subjects and Mental Ability

Subjects were 617 students selected from schools in the Bellflower Unified School District, Bellflower, California. Approximately equal number of fifth grade boys, fifth grade girls, sixth grade boys and sixth grade girls comprised the experimental population. The district was selected because it met the criterion of large numbers of experimental subjects at all levels of mental ability and had computerized student data. From the original number of students tested, 576 of the students were present for the administration of the retention test.

Both fifth and sixth grade students reading below the fourth grade level were eliminated from the experiment. Fifth graders reading on or below the eleventh percentile (approximately fourth grade reading ability), on the Sequential Test of Education Progress (E.T.A., 1963) and sixth grade students reading below the fourth grade level as determined by grade placement of this verbal battery (Level D Form 1) Lorge-Thorndike Intelligence Test (1964) were eliminated from the study.

The remaining fifth and sixth grade students were divided into high medium, and low mental ability groups. This was accomplished by making separate student mental ability frequency distributions for fifth and sixth grade students in each school. The Verbal Battery of the School and College Achievement Tests (1957) (SCAT) were used to determine the fifth grade student mental ability level and the Verbal Battery (Level D, Form 1) Lorge-Thorndike Intelligence Test (1964) mental ability scores were used to place sixth grade students on the mental ability distribution. The mental ability distributions were divided equally into high, medium, and low mental ability groups.

The seven content area films were randomly assigned to the experimental schools. The mental ability groupings by grade and content are reflected in Table 1.

TABLE 1

STUDENT MENTAL ABILITY GROUPINGS BY CONTENT AREA

Grade	Content Film Areas	Mental Ability Designations		
		Low	Medium	High
Fifth	(All Seven Content Areas)	42% or below	52%-62%	68% or above[1]
Sixth	#1 Thailand	95 or below	104-96	105 or above[2]
	#2 Irrigation	95 or below	104-96	105 or above
	#3 India	97 or below	111-99	112 or above
	#4 Labor	98 or below	107-99	108 or above
	#5 Heat	95 or below	105-96	106 or above
	#6 Salamanders	96 or below	106-97	107 or above
	#7 Mountains	96 or below	106-97	107 or above

[1] Verbal Battery--Lorge-Thorndike Intelligence Test (1964).

[2] SCAT (1957).

Using a table of random numbers, the students from the mental ability groups were assigned to one of seven presentation modes for the subject content areas.

Presentation Mode

Each of the seven visual-verbal presentation modes was designed to contain the same information within a single content area.

1. Motion picture with spoken verbal mode was

presented with sound motion picture film which contained both live and animated pictorial material. The narration was designed to describe simultaneously the content of the visual mode.

2. Motion picture without spoken verbal mode utilized identical visual material of mode #1 without a spoken narration.

3. Still picture with spoken verbal mode presented selected frames reproduced on a half frame 35mm slide from the motion picture film with the identical spoken verbal used in mode #1.

4. Still pictures without spoken verbal mode presented identical visual material as mode #3, but did not contain spoken verbal.

5. Print with spoken verbal mode presented a printed narration with simultaneous spoken verbal from a tape recorder.

6. Print mode used identical spoken verbal narration in print form.

7. Spoken verbal mode was the narration presented as an audio recording.

Presentation and Test Materials

Presentation Materials

The presentation materials included motion picture film, slides, audio tape and printed booklets. Seven existing commercially produced silent super 8mm motion pictures were selected as meeting the criteria for instruction in the three learning objectives. The films used were as follows:

#1 (Thailand)	"Floating Markets of Thailand"
#2 (Irrigation)	"Egyptian Village Irrigation"
#3 (India)	"Transportation in India"
#4 (Labor)	"Use of Labor in Eastern Europe"
#5 (Heat)	"Heat Can Do Work"
#6 (Salamanders)	"Salamanders"
#7 (Mountains)	"Dome and Volcanic Mountains"

The seven two to three minute films covered material in the social studies and science curriculum areas not normally taught in the fifth or sixth grades, but suitable for upper elementary students. The selected films met the criteria of containing only a limited number of predominant concepts. Verbal narrations were developed for each film using a "redundant sound" technique utilized in a media study by Allen, Cooney and Weintraub (1968). This provided a spoken verbal narration in which the content appearing in the visuals was described literally and simultaneously in the audio narration. As Allen explains, this technique produces two possible effects upon learning: (1) an increase in learning resulting from similar content through two sensory channels, or (2) a reduction in learning because of the simultaneous nature of the visual and audio presentation may cause channel interference. The verbal narration developed for the motion picture was also used for the spoken verbal in all presentation modes with sound and in printed form for the print mode.

Still picture materials were reproduced from selected frames of the motion picture films. With the use of a Repronar, a half-frame 35mm Ektachrome transparency was copied from the motion picture film to produce the still picture versions.

After a magnetic stripe was applied to the motion picture film, the audio narration was recorded on the stripe for use in the motion picture sound projector. The audio segments for the still picture, print, and spoken verbal presentation modes were recorded on magnetic tape cassette. Inaudible pulses were added to the tape to synchronize and advance the pictures in the still picture mode. This process provided the still picture modes with identical sequence and timing of content as that presented in the motion picture version. The still picture mode without spoken verbal was accomplished by utilizing the synchronizing pulses on the tape without using the audio narration. To produce the motion picture silent mode the projector's amplifier was turned off; thus, the motion picture without spoken verbal mode was the same visual presentation as the motion picture with spoken verbal.

The audio narration developed for each content area was reproduced in a printed form for the print with spoken verbal mode as well as for the print mode.

To summarize the modes, the only difference in the two motion picture modes was that one had a spoken verbal narration. The only difference in the two still picture modes was one carried a spoken verbal narration. One mode combined the audio and printed spoken verbal narration, one mode which presented the printed version of the spoken verbal narration and one mode which presented the audio spoken verbal narration.

To summarize the presentation modes in terms of single and multi-channel channels: four modes--motion picture silent, still picture silent, printed words and spoken verbal--were designated as single channel modes because the learner was receiving stimuli through a single sensory channel and three modes were designated as multichannel when the spoken verbal accompanied the motion picture, still picture and printed word modes.

Performance Tests

Seven performance tests were developed for the study, one for each of film content areas and are shown in Appendix C. Each test included items to measure the learning of identifications, comparisons, classifications, generalizations, and applications. However, only the latter three are covered in this dissertation. The other two are part of another study as cited at the end of Chapter I.

Performance test materials were subjected to a tryout-revise-tryout-revise development process. Two tryouts phases were conducted. In the first tryout fifth and sixth grade students not part of the experimental population were exposed to the motion picture with spoken verbal treatment. Following the presentation mode the posttest questions were projected individually onto a screen. A research assistant read aloud the entire question and responses, and the subjects responded on specially prepared answer sheets. During this phase, test item completion time was recorded, student response to materials was observed and recorded and procedural details and instructions to students were studied for needed improvements.

In the second tryout phase only the posttest question stem was read aloud and the responses were read silently by the students. This change was made because the reading procedure was found to be unsatisfactory--as the responses were read aloud students would lower their heads to mark answers. Other students were found to cue from the head movement and mark their answer sheets correspondingly. Otherwise, the test procedure was essentially the same with only minor improvements made in the test and answer sheet marking instructions.

Therefore, students were presented information followed by the performance test. The question stem was read aloud and the responses were read silently by the students. Each question number appeared on the answer sheet followed by the four to nine lettered responses. Students simply circled the lettered response or "appropriate choice" on the answer sheet.

The test item results of both tryout phases were analyzed on a Honeywell 800 computer using the Kuder-Richardson Formula #21. This procedure provided two figures upon which to judge test item reliability; a phi coefficient and percentage proportion of upper half to lower half responding correctly. The object of the test item revision was to achieve a balance in question responses from "easy to difficult" as the reliability figures indicated for each item. Most test items responses had approximately a .3 to .5 phi coefficient range and a proportion figure between .300 to .700.

A third reliability figure also resulted from the Kuder-Richardson computer program. This figure indicated the item intercorrelation reliability factor for items within each film area for each learning objective on the tryout test. However, these test reliability figures were extremely low and distorted because of the following factors:

1. There was a small number of test items, two-to-eight, in a learning objective category.
2. Test items were not of equal difficulty.
3. The item variance was not designed near the maximum, .50 proportion passing the item, in all test item situations.

Therefore, these particular learning objective reliability figures were not utilized.

A test reliability figure for each film content area and learning objective was computed from the posttest analysis of variance, a total of 21 reliability figures. The test reliability results were reported for the highest, lowest and average test reliability figures among the seven film content areas for each learning objective level:

Application objective	.303, .193, and .262
Generalization objective	.393, .174, and .250
Classification objective	.385, .180, and .298

Retention Test

The retention test was identical to the performance test but was printed in booklet form, and the subjects were required to read the entire test item. The students responded to the items by marking their choices on the same type of specially prepared answer sheets that were used for the performance test.

Instrumentation

A super 8mm Bauer T-4 sound projector with zoom lens was used for motion picture presentation modes. Still picture presentation modes utilized a Kodak Carousel, model AV900, slide projector with zoom lens. The zoom lenses allowed identical projected image sizes for still and motion modes on the six square foot matte white screen. The spoken verbal materials, with the exception of motion picture with spoken verbal mode, were presented with a Norelco LCH 1000, cassette tape recorder and pulsing control system for advancing slides.

The projection and audio equipment were placed on a portable projection stand in the rear of each classroom and folding chairs were set in front of the projection screen.

Field Procedure

Schedules and procedures were developed in detail with the administrative staff of each school and then were reviewed with teachers involved in the study.

After the equipment was set up in a projection classroom, teachers involved were given instructions as to the nature of the experiment. A list of students to be tested was given to each teacher. Individual coded cards which indicated student name and the time he was to report to the testing room were also given teachers.

There were about 12 students assigned, four each, to the high, medium and low mental ability levels in each presentation mode. Assigned absentees were replaced from a pool of extra students by grade, sex and mental ability level.

Students were given instructions as to the nature of the experiment, a brief description of the presentation mode to be seen, and the marking procedure for the score sheet. The experimental stimulus designated for that group was then given and followed immediately by administration of the performance test questions. Each question was projected, one at a time, on the screen and the question stem was read aloud by a research assistant. The student read the answer choices to himself and marked his answers on the answer sheet. Presentation of each mode took approximately 30 minutes. Each of the seven verbal-visual presentation modes was conducted identically.

About two weeks after the posttest, the retention test was administered. All students assigned in the posttest to one of the seven film content areas were tested at the same time. Each student received a test booklet on the film content area he was exposed to in the posttest.

Preparation of Data

Recording the Data

During the experiment, subjects marked answers directly on score sheets. These score sheets were grouped by presentation mode and the student responses were transferred to IBM sensescore sheets by research assistants.

School district student data cards provided mental ability test data, sex, grade and student identification numbers. These data were transferred with performance test scores, content film identification number, mental ability group and presentation mode to the IBM sensescore sheet and used in all analyses.

The IBM score sheets were compared with original score sheets and school district data by a second individual to eliminate errors in marking. Information on the sensescore sheets was transferred to IBM cards by the University of Southern California Testing Bureau for further analyses. Analysis of test items responses provided an individual item score and a total score for each learning objective. All quantitative data were analyzed by computer.

Statistical Analysis

A two-way analysis of variance was used to test several hypotheses. This procedure allowed both variables--presentation mode and mental ability--to vary at one time. Therefore, the following statements were explained: the main effect of the presentation mode on performance test scores, the main effect of mental ability on performance test scores and the interaction effect of presentation mode and mental ability upon performance test scores. A two-way analysis of variance was also utilized to establish the main effect of single and multi-channel presentation modes upon performance test scores and the interaction of single and multi-channel presentation modes and mental ability. Where significant differences at the .05 level or below were found among modes or mental ability levels a Duncan Multiple Range Test was used to identify which particular mode or mental ability caused the significant difference. The analysis of variance concluded only that various post-test means differ significantly. The Duncan Multiple Range Test was designed to test how the means differ and particularly when multiple comparisons among means were involved. The statistical power of the test increased as the number of observations in the sample are grouped for comparisons. Therefore, this procedure reduces the possibility of Type II errors--when the null hypothesis is, in fact, false but it is not rejected.

The underlying analysis of variance assumptions were fulfilled: the contributions to the variance in total sample were additive, observations within sets were mutually independent, the variances within homogeneous sets were approximately equal, and variations within homogeneous sets were from a normally distributed population. These assumptions were met by random assignment of students from the pool for each mental ability level for each presentation made.

The main variable analyses were performed in a

BMD05V analysis of variance computer program on a Honeywell 800 computer. The analysis of single and multi-channel variables was performed with a BMD07V analysis of variance program on an IBM 360 computer. All statistical analyses were accomplished on the computers operated by the staff of the Computer Sciences Laboratory, University of Southern California.

CHAPTER IV

RESULTS

In this chapter the results from analyses of the data are reported for each restated hypothesis. All analyses of the data are based on posttest or retention test performance scores as shown in Appendix A.

Hypothesis One

The seven visual-verbal presentation modes produce significant differences in mean performance scores, summed across mental ability, for the population sampled for each content area and learning objective.

Results

The results of the two-way analysis of variance for each learning objective and content area are shown in Tables 2, 4, and 6. The comparison of presentation mode posttest means for combined mental ability levels and for each learning objective are shown in Tables 3, 5, and 7.

An examination of the results indicated only four significant differences in the 21 comparisons among presentation modes. The differences among modes appeared in each learning objective.

TABLE 2

ANALYSIS OF VARIANCE FOR POSTTEST SCORES OF THE APPLICATION OBJECTIVE

Content	Source	df	MS	F	Prob.
1 Thailand	Presentation Modes (A)	6	2.930	1.845	--
	Mental Abilities (B)	2	.253	.159	--
	A × B	12	1.166	.734	--
	Within	63	1.587		
2 Irrigation	Presentation Modes (A)	6	15.587	1.791	--
	Mental Abilities (B)	2	36.112	4.150	< .05
	A × B	12	7.30	.835	--
	Within	67	11.686		
3 India	Presentation Modes (A)	6	4.059	1.480	--
	Mental Abilities (B)	2	.398	.145	--
	A × B	12	1.086	.761	--
	Within	76	2.741		
4 Labor	Presentation Modes (A)	6	5.151	2.369	< .05
	Mental Abilities (B)	2	.111	.051	--
	A × B	12	1.860	.859	--
	Within	63	2.174		
5 Heat	Presentation Modes (A)	6	6.674	1.726	--
	Mental Abilities (B)	2	2.113	.530	--
	A × B	12	5.086	1.277	--
	Within	64	3.980		
6 Salamanders	Presentation Modes (A)	6	5.759	1.722	--
	Mental Ability (B)	2	1.088	.325	--
	A × B	12	3.744	1.119	--
	Within	60	3.343		
7 Mountains	Presentation Modes (A)	6	3.997	.753	--
	Mental Ability (B)	2	30.968	5.820	< .01
	A × B	12	3.349	.631	--
	Within	77	5.303		

TABLE 3

COMPARISON OF PRESENTATION MODE POSTTEST MEANS FOR COMBINED MENTAL ABILITY LEVELS ON THE APPLICATION OBJECTIVE

Content	Mode	Rank	$\bar{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
1 Thailand	MpS	1	8.000	1.809	12	77	
	Mp	4	7.167	1.114	12		
	SpS	3	7.333	0.778	12		
	Sp	7	6.417	1.240	12		
	PrS	5	7.167	1.114	12		
	Pr	6	7.000	1.128	12		
	S	2	7.583	1.164	12		
2 Irrigation	MpS	2	13.833	2.979	12	81	
	Mp	1	14.467	2.799	15		
	SpS	3	12.917	4.122	12		
	Sp	7	11.750	2.416	12		
	PrS	6	11.833	2.587	12		
	Pr	5	12.167	3.128	12		
	S	4	12.692	2.780	13		
3 India	MpS	6	5.706	1.263	17	90	
	Mp	4	5.889	1.676	18		
	SpS	5	5.765	1.437	17		
	Sp	1	6.455	1.213	11		
	PrS	2	6.400	1.712	10		
	Pr	7	4.667	2.146	12		
	S	3	6.250	1.815	12		
4 Labor	MpS	3	6.500	1.243	12	77	S/Pr > MpS/Mp/Sp S > MpS/Mp/Sp
	Mp	2	6.333	1.723	12		
	SpS	4	6.833	0.577	12		
	Sp	1	6.167	1.403	12		
	PrS	5	7.083	1.505	12		
	Pr	6	7.667	1.614	12		
	S	7	7.917	1.676	12		
5 Heat	MpS	3	6.000	1.705	12	78	
	Mp	4	6.308	1.974	13		
	SpS	1	5.667	2.015	12		
	Sp	6	6.364	2.838	11		
	PrS	2	5.923	1.801	13		
	Pr	5	6.333	1.497	12		
	S	7	7.917	2.234	12		

TABLE 3--continued

Content	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
6 Salamanders	MpS	6	8.167	2.124	12	74	
	Mp	1	7.000	2.044	12		
	SpS	4	7.917	1.564	12		
	Sp	2	7.300	2.162	10		
	PrS	5	8.091	1.640	11		
	Pr	7	9.250	1.864	12		
	S	3	7.583	1.240	12		
7 Mountains	MpS	6	12.000	1.664	14	91	
	Mp	3	11.571	3.056	14		
	SpS	7	12.538	2.221	13		
	Sp	2	11.333	2.870	12		
	PrS	1	11.083	2.503	12		
	Pr	5	12.000	1.847	18		
	S	4	11.667	2.160	15		

TABLE 4

ANALYSIS OF VARIANCE FOR POSTTEST SCORES
OF THE GENERALIZATION OBJECTIVE

Content	Source	df	MS	F	Prob.
1 Thailand	Presentation Modes (A)	6	1.603	.645	--
	Mental Abilities (B)	2	9.122	1.238	--
	A × B	12	.512	.612	--
	Within	63	2.484		
2 Irrigation	Presentation Modes (A)	6	13.081	2.336	< .05
	Mental Abilities (B)	2	45.426	8.122	< .01
	A × B	12	6.52	1.167	--
	Within	67	5.597		
3 India	Presentation Modes (A)	6	7.653	2.656	< .05
	Mental Abilities (B)	2	4.405	1.529	--
	A × B	12	1.260	.438	--
	Within	76	2.880		
4 Labor	Presentation Modes (A)	6	1.065	.319	--
	Mental Abilities (B)	2	17.992	5.554	< .01
	A × B	12	3.253	.947	--
	Within	63	3.327		
5 Heat	Presentation Modes (A)	6	5.490	1.390	--
	Mental Abilities (B)	2	8.446	2.138	--
	A × B	12	2.326	.589	--
	Within	64	3.949		
6 Salamanders	Presentation Modes (A)	6	4.653	1.001	--
	Mental Ability (B)	2	6.757	1.347	--
	A × B	12	1.884	.405	--
	Within	60	4.645		
7 Mountains	Presentation Modes (A)	6	7.401	1.690	--
	Mental Ability (B)	2	34.738	7.938	< .01
	A × B	12	2.634	.602	--
	Within	77	4.375		

TABLE 5

COMPARISON OF PRESENTATION MODE POSTTEST MEANS FOR COMBINED MENTAL ABILITY LEVELS ON THE GENERALIZATION OBJECTIVE

Content	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
1 Thailand	MpS	5	8.083	1.443	12	77	
	Mp	4	8.083	1.676	12		
	SpS	7	8.583	1.240	12		
	Sp	3	8.000	1.651	12		
	PrS	2	8.000	1.348	12		
	Pr	1	7.667	1.614	12		
	S	6	8.583	1.621	12		
2 Irrigation	MpS	6	14.667	1.969	12	81	
	Mp	4	14.600	2.746	15		
	SpS	5	14.667	2.348	12		
	Sp	3	14.500	1.167	12		
	PrS	7	14.750	2.927	12		
	Pr	2	13.000	3.437	12		
	S	1	12.615	2.567	13		
3 India	MpS	5	7.294	1.759	17	90	PrS/SpS/MpS/Mp > Sp/S
	Mp	4	7.278	1.363	18		
	SpS	6	7.353	1.765	17		
	Sp	1	5.818	1.470	11		
	PrS	7	7.600	1.577	10		
	Pr	3	6.667	1.775	12		
	S	2	5.833	1.749	12		
4 Labor	MpS	7	8.750	1.215	12	77	
	Mp	1	7.917	2.065	12		
	SpS	3	8.000	1.595	12		
	Sp	2	8.000	2.000	12		
	PrS	5	8.500	1.446	12		
	Pr	6	8.583	2.539	12		
	S	4	8.333	2.015	12		
5 Heat	MpS	4	6.833	1.992	12	78	
	Mp	5	7.154	1.405	13		
	SpS	3	6.583	2.151	12		
	Sp	2	6.273	1.793	11		
	PrS	7	7.538	2.436	13		
	Pr	1	5.917	1.831	12		
	S	6	7.500	1.930	12		

TABLE 5--continued

Content	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
6 Salamanders	MpS	4	10.583	1.880	12	74	
	Mp	2	10.333	2.103	12		
	SpS	6	10.917	1.083	12		
	Sp	1	9.200	2.936	10		
	PrS	7	11.000	1.788	11		
	Pr	5	10.917	2.151	12		
	S	3	10.500	2.195	12		
7 Mountains	MpS	4	12.143	2.107	14	91	
	Mp	6	12.786	2.006	14		
	SpS	7	12.923	2.900	13		
	Sp	3	11.667	1.874	12		
	PrS	2	11.500	2.110	12		
	Pr	5	12.556	1.756	18		
	S	1	11.067	2.491	15		

TABLE 6

ANALYSIS OF VARIANCE FOR POSTTEST SCORES OF THE CLASSIFICATION OBJECTIVE

Content	Source	df	MS	F	Prob.
1 Thailand	Presentation Modes (A)	6	10.175	2.009	< .10
	Mental Abilities (B)	2	26.583	5.250	< .01
	A × B	12	3.070	.606	--
	Within	63	5.063		
2 Irrigation	Presentation Modes (A)	6	2.856	.997	--
	Mental Abilities (B)	2	2.470	.862	--
	A × B	12	1.693	.589	--
	Within	67	2.864		
3 India	Presentation Modes (A)	6	7.950	1.501	--
	Mental Abilities (B)	2	2.832	.534	--
	A × B	12	3.440	.630	--
	Within	76	5.295		
4 Labor	Presentation Modes (A)	6	12.116	2.711	< .05
	Mental Abilities (B)	2	5.132	1.148	--
	A × B	12	7.786	1.740	< .10
	Within	63	4.468		
5 Heat	Presentation Modes (A)	6	11.102	2.180	--
	Mental Abilities (B)	2	14.878	2.921	< .10
	A × B	12	7.619	1.490	--
	Within	64	5.090		
6 Salamanders	Presentation Modes (A)	6	5.768	2.074	< .10
	Mental Ability (B)	2	5.143	1.849	--
	A × B	12	3.323	1.135	--
	Within	60	2.780		
7 Mountains	Presentation Modes (A)	6	.560	.324	--
	Mental Ability (B)	2	8.274	5.054	< .01
	A × B	12	2.789	1.703	--
	Within	77	1.636		

TABLE 7

COMPARISON OF PRESENTATION MODE POSTTEST MEANS FOR COMBINED MENTAL ABILITY LEVELS ON THE CLASSIFICATION OBJECTIVE

Content	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test α = .05
1 Thailand	MpS	7	13.750	2.632	12	77	
	Mp	6	13.667	1.557	12		
	SpS	5	13.583	1.729	12		
	Sp	2	12.000	2.044	12		
	PrS	4	13.500	3.316	12		
	Pr	1	11.833	2.249	12		
	S	3	12.667	2.059	12		
2 Irrigation	MpS	7	5.000	0.852	12	81	
	Mp	6	5.000	1.647	15		
	SpS	4	4.917	2.020	12		
	Sp	1	3.833	1.585	12		
	PrS	3	4.500	1.882	12		
	Pr	5	5.000	1.537	12		
	S	2	4.154	1.625	13		
3 India	MpS	17	11.353	2.148	17	90	
	Mp	18	10.722	2.986	18		
	SpS	17	12.000	1.903	17		
	Sp	11	9.636	2.656	11		
	PrS	10	10.300	1.418	10		
	Pr	12	10.667	2.059	12		
	S	12	11.000	1.595	12		
4 Labor	MpS	7	11.833	1.800	12	77	MpS/SpS > Mp/Sp/S
	Mp	1	9.167	2.480	12		
	SpS	6	11.750	2.340	12		
	Sp	2	9.250	2.301	12		
	PrS	5	10.500	2.276	12		
	Pr	4	10.083	1.928	12		
	S	3	9.750	2.378	12		
5 Heat	MpS	5	13.833	2.918	12	78	
	Mp	6	14.000	2.121	13		
	SpS	7	15.000	1.348	12		
	Sp	1	12.727	2.935	11		
	PrS	3	12.923	2.596	13		
	Pr	2	12.750	1.959	12		
	S	4	13.250	2.490	12		

TABLE 7--continued

Content	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
6 Salamanders	MpS	6	4.833	2.124	12	74	
	Mp	4	4.333	1.302	12		
	SpS	7	5.667	1.825	12		
	Sp	2	3.900	1.969	10		
	PrS	3	4.182	1.401	11		
	Pr	5	4.583	1.781	12		
	S	1	3.583	1.164	12		
7 Mountains	MpS	4	5.786	1.528	14	91	
	Mp	3	5.643	1.081	14		
	SpS	2	5.538	1.450	13		
	Sp	5	6.000	1.128	12		
	PrS	7	6.250	1.288	12		
	Pr	6	6.167	1.150	18		
	S	1	5.533	1.807	15		

Application Objective

One significant difference was found among modes on this learning objective in the content area Labor. The Duncan Multiple Range Test indicated a superiority for the spoken verbal and print modes. This means that these particular modes produced superior test achievement means when compared with other presentation modes in the film content area Labor. In the other six content areas no presentation mode emerged as being superior in its ability to produce significantly different test scores on the application objective.

Generalization Objective

Two significant differences in the analysis of variance were found among presentation modes for this learning objective. The Duncan Multiple Range Test indicated a significant superiority over other modes for print with spoken verbal, still picture with spoken verbal and the motion picture with spoken verbal modes in the content area India. While the analysis of variance indicated a significant difference among presentation modes in the content area Irrigation, the difference was not large enough for identification of a particular superior mode in the Duncan Multiple Range Test. However, the pattern for the significant modes was very similar to the significant mode findings in the content area India.

Classification Objective

One significant difference was found for motion and still picture with spoken verbal modes over other modes in the content area Labor. This means that in only one comparison did a presentation mode emerge as being superior to the other modes when comparing test score means for the classification objective.

Conclusions

The hypothesis was supported in only a limited number of comparisons in each of the learning objectives. There appears to have been no presentation mode superiority across the three learn objectives, however, the print and spoken verbal modes produced significantly superior performance test scores on the application objective while visual modes with spoken verbal produced superior test scores among modes in the classification objective. The results confirm the hypothesis that the presentation modes produce significant differences in mean performance scores depending upon the learning objectives: application, generalization or classification.

The significance of the results, while limited, is the fact that particular modes have unique capabilities to produce significantly different test performance score depending upon the learning task involved.

Hypothesis Two

The three levels of mental ability will produce significant differences in mean performance scores, summed across mental ability, for the population sampled for each content area and learning objective.

Results

The results of the two-way analysis of variance for mental ability levels are shown in Tables 2, 4, and 6. The results indicated seven significant differences among mental ability comparisons: two within the application objective, three within the generalization objective, and two within the classification objective.

Application Objective

The analysis of variance revealed two significant differences in the mental ability comparisons for the seven content areas. The Duncan Multiple Range Test indicated that in both Irrigation and Mountains the high mental ability group did significantly better than the low group.

Generalization Objective

On this objective significant differences among mental abilities were found in content areas--Irrigation, Labor, and Mountains. In the content areas Irrigation and Labor, the Duncan Multiple Range Test indicated the high mental ability group was significantly superior to either

TABLE 8

COMPARISON OF MENTAL ABILITY LEVELS FOR COMBINED PRESENTATION MODES ON THE APPLICATION OBJECTIVE

Content	M.A. Level	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
1 Thailand	High	3	7.107	1.423	28	81	
	Med.	1	7.321	1.362	28		
	Low	2	7.286	1.013	28		
2 Irrigation	High	1	14.103	2.380	29	85	High > Med/Low
	Med.	3	12.194	3.340	31		
	Low	2	12.321	3.079	28		
3 India	High	3	5.724	1.411	29	94	
	Med.	2	5.824	1.914	34		
	Low	1	5.971	1.585	34		
4 Labor	High	1	7.000	1.587	28	81	
	Med.	2.5	6.893	1.396	28		
	Low	2.5	6.893	1.617	28		
5 Heat	High	3	6.000	2.070	29	82	
	Med.	1	6.690	1.929	29		
	Low	2	6.370	2.238	27		
6 Salamanders	High	3	7.786	2.149	28	78	
	Med.	1	8.154	1.953	26		
	Low	2	7.815	1.545	27		
7 Mountains	High	1	12.931	2.202	29	95	High > Med/Low
	Med.	2	11.375	2.136	32		
	Low	3	11.189	2.258	37		

TABLE 9

COMPARISON OF MENTAL ABILITY LEVELS FOR COMBINED PRESENTATION MODES ON THE GENERALIZATION OBJECTIVE

Content	M.A. Level	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
1 Thailand	High Med. Low	1 2 3	8.500 8.071 7.857	1.598 1.561 1.297	28 28 28	81	
2 Irrigation	High Med. Low	1 3 2	15.458 13.355 13.536	2.458 2.537 2.317	29 31 28	85	High > Med/Low
3 India	High Med. Low	1 2 3	7.172 7.000 6.588	1.814 1.705 1.653	29 34 34	94	
4 Labor	High Med. Low	1 2 3	9.179 8.143 7.571	1.389 1.957 1.814	28 28 28	81	High > Med/Low
5 Heat	High Med. Low	1 2 3	7.448 6.655 6.407	2.147 1.674 1.985	29 29 27	82	
6 Salamanders	High Med. Low	3 1 2	10.036 10.885 10.667	2.235 2.196 1.664	28 26 27	78	
7 Mountains	High Med. Low	1 2 3	13.034 12.437 11.108	1.936 1.899 2.342	29 32 37	95	High/Med > Low

TABLE 10

COMPARISON OF MENTAL ABILITY LEVELS FOR COMBINED PRESENTATION MODES ON THE CLASSIFICATION OBJECTIVE

Content	M.A. Level	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
1 Thailand	High	1	14.107	1.872	28	81	High > Med/Low
	Med.	2	12.679	2.195	28		
	Low	3	12.214	2.543	28		
2 Irrigation	High	1	4.966	1.898	29	85	
	Med.	2	4.484	1.546	31		
	Low	3	4.464	1.426	28		
3 India	High	1	11.172	2.497	29	94	
	Med.	3	10.676	2.566	34		
	Low	2	10.941	1.739	34		
4 Labor	High	1	10.607	2.042	28	81	
	Med.	2	10.464	2.252	28		
	Low	3	9.929	2.801	28		
5 Heat	High	1	14.310	2.522	29	82	High > Med > Low
	Med.	2	13.241	2.339	29		
	Low	3	12.926	2.268	27		
6 Salamanders	High	1	4.929	1.513	28	78	
	Med.	2	4.308	1.849	26		
	Low	3	4.111	1.804	27		
7 Mountains	High	1	6.207	1.114	29	95	High/Med > Low
	Med.	2	6.094	1.201	32		
	Low	3	5.351	1.531	37		

the medium or low groups. In the content area, Mountains, the high and medium mental ability groups were found to have produced significantly superior achievement levels over the low group.

Classification Objective

Within the classification objective, significant differences were found in the film areas Thailand and Mountains. Again, the high mental ability level group produced significantly superior scores than either the medium or low group in the content area Thailand.

In the content area Mountains, both high and medium mental group produced mean performance significantly superior to the low group. No significant differences were found among mental ability groups in the other film content areas.

Conclusions

Thus the hypothesis was supported in only a seven of 21 comparisons in the three learning objectives. The high mental ability group produced significantly better performance scores where significant differences were found. Regardless of media presentation, the high mental ability group produced significantly different or superior test scores.

Hypothesis Three

The main effects of presentation mode and mental ability interact to produce significant differences on mean performance scores for each content area and learning objective.

Results

The results of the two-way analysis of variance, shown in Tables 2, 4, and 6, indicated the interaction of mental ability and presentation mode produced no significant differences in performance scores.

Conclusions

There appeared to be no evidence to support an interaction of presentation mode with mental ability. Thus, the hypothesis was not supported in any content area or learning objective.

Hypothesis Four

The seven visual-verbal presentation modes will produce similar significant differences in mean performance scores, summed across mental ability, for the population sampled in both posttest and retention test for each content area and learning objective.

Results

The posttest analysis of variance results for each learning objective is shown in Tables 2, 4, and 6; retention test results are shown in Tables 11, 12, and 13, and posttest and retention tests are compared and summarized in Tables 14, 15, and 16.

Application Objective

The single significant difference among presentation modes found in the posttest did not reach significance in the retention test. In the content area Irrigation a significant presentation mode difference appeared in the retention test which did not appear in the posttest. One of the two significant mental ability differences in the posttest reappeared in the retention test.

Generalization Objective

Two significant presentation mode differences appeared in the posttest and while one significant difference carried over in the retention test the other significant F ratio did not reappear.

Significant mental ability differences in the posttest scores in general, also appeared to be similar. Specifically, two significant differences reappeared in the retention test while one difference did not reappear. A significant mental ability difference also appeared in the retention test for the content area India which was not present in the posttest.

TABLE 11

ANALYSIS OF VARIANCE FOR RETENTION TEST SCORES OF THE APPLICATION OBJECTIVE

Content	Source	df	MS	F	Prob.
1 Thailand	Presentation Modes (A)	6	2.152	1.666	--
	Mental Abilities (B)	2	5.160	.123	--
	A × B	12	.937	.725	--
	Within	54	1.295		
2 Irrigation	Presentation Modes (A)	6	18.112	2.260	< .05
	Mental Abilities (B)	2	18.929	2.360	--
	A × B	12	7.270	.908	--
	Within	65	8.006		
3 India	Presentation Modes (A)	6	4.376	1.424	--
	Mental Abilities (B)	2	3.396	1.105	--
	A × B	12	2.227	.725	--
	Within	72	3.071		
4 Labor	Presentation Modes (A)	6	28.109	1.848	< .10
	Mental Abilities (B)	2	.685	.045	--
	A × B	12	15.331	1.008	--
	Within	58	15.207		
5 Heat	Presentation Modes (A)	6	6.973	1.296	--
	Mental Abilities (B)	2	9.107	1.692	--
	A × B	12	5.905	1.097	--
	Within	56	5.379		
6 Salamanders	Presentation Modes (A)	6	3.464	.877	--
	Mental Ability (B)	2	1.484	.376	--
	A × B	12	3.538	.896	--
	Within	53	3.964		
7 Mountains	Presentation Modes (A)	6	4.603	.920	--
	Mental Ability (B)	2	16.487	3.296	< .05
	A × B	12	1.804	.360	--
	Within	72	5.001		

TABLE 12

ANALYSIS OF VARIANCE FOR RETENTION TEST SCORES OF THE GENERALIZATION OBJECTIVE

Content	Source	df	MS	F	Prob.
1 Thailand	Presentation Modes (A)	6	1.235	.435	--
	Mental Abilities (B)	2	7.100	2.504	< .10
	A × B	12	3.876	1.367	--
	Within	54	2.834		
2 Irrigation	Presentation Modes (A)	6	17.878	3.714	< .01
	Mental Abilities (B)	2	9.748	12.413	< .01
	A × B	12	7.809	1.622	--
	Within	65	4.813		
3 India	Presentation Modes (A)	6	3.652	1.260	--
	Mental Abilities (B)	2	9.205	3.012	< .05
	A × B	12	1.832	.599	--
	Within	72	3.056		
4 Labor	Presentation Modes (A)	6	5.506	1.271	--
	Mental Abilities (B)	2	7.742	1.788	--
	A × B	12	4.188	.967	--
	Within	58	4.329		
5 Heat	Presentation Modes (A)	6	2.614	.883	--
	Mental Abilities (B)	2	8.525	2.676	< .10
	A × B	12	2.702	.848	--
	Within	56	3.184		
6 Salamanders	Presentation Modes (A)	6	3.550	.659	--
	Mental Ability (B)	2	1.034	.192	--
	A × B	12	5.068	.941	--
	Within	53	5.383		
7 Mountains	Presentation Modes (A)	6	3.743	.640	--
	Mental Ability (B)	2	74.679	7.388	< .01
	A × B	12	6.658	1.139	--
	Within	72	5.850		

TABLE 13

ANALYSIS OF VARIANCE FOR RETENTION TEST SCORES OF THE CLASSIFICATION OBJECTIVE

Content	Source	df	MS	F	Prob.
1 Thailand	Presentation Modes (A)	6	14.713	2.631	< .05
	Mental Abilities (B)	2	13.015	2.327	< .10
	A × B	12	5.887	1.052	--
	Within	54	5.591		
2 Irrigation	Presentation Modes (A)	6	8.785	4.157	< .01
	Mental Abilities (B)	2	7.675	3.632	--
	A × B	12	4.295	2.032	< .05
	Within	65	2.113		
3 India	Presentation Modes (A)	6	2.756	.469	--
	Mental Abilities (B)	2	14.453	2.458	< .10
	A × B	12	8.272	1.407	--
	Within	72	5.870		
4 Labor	Presentation Modes (A)	6	5.753	.821	--
	Mental Abilities (B)	2	15.816	2.258	--
	A × B	12	7.943	1.135	--
	Within	58	7.001		
5 Heat	Presentation Modes (A)	6	9.272	1.188	--
	Mental Abilities (B)	2	8.788	1.126	--
	A × B	12	13.610	1.743	< .10
	Within	56	7.800		
6 Salamanders	Presentation Modes (A)	6	6.202	1.891	< .10
	Mental Ability (B)	2	5.637	1.719	--
	A × B	12	2.460	.751	--
	Within	53	3.288		
7 Mountains	Presentation Modes (A)	6	2.780	1.418	--
	Mental Ability (B)	2	8.800	4.490	< .05
	A × B	12	1.530	.660	--
	Within	72	1.960		

TABLE 14

SUMMARY OF THE ANALYSIS OF VARIANCE FOR POSTTEST AND RETENTION TEST ON THE APPLICATION OBJECTIVE

Content	Source	Posttest			Retention Test		
		df	F	P	df	F	P
1 Thailand	Presentation Modes (A)	6/63	1.845		6/54	1.666	
	Mental Abilities (B)	2/63	.159		2/54	.123	
	A × B	12/63	.734		12/54	.725	
2 Irrigation	Presentation Modes (A)	6/67	1.791		6/65	2.265	< .05
	Mental Abilities (B)	2/67	4.150	< .05	2/65	2.360	
	A × B	12/67	.838		12/65	.980	
3 India	Presentation Modes (A)	6/76	1.480		6/72	1.424	
	Mental Abilities (B)	2/76	.145		2/72	1.105	
	A × B	12/76	.761		12/72	.725	
4 Labor	Presentation Modes (A)	6/63	2.369	< .05	6/58	1.848	
	Mental Abilities (B)	2/63	.051		2/58	.045	
	A × B	12/63	.857		12/58	1.008	
5 Heat	Presentation Modes (A)	6/64	1.726		6/56	1.296	
	Mental Abilities (B)	2/64	.530		2/56	1.690	
	A × B	12/64	1.277		12/56	1.097	
6 Salamanders	Presentation Modes (A)	6/60	1.722		6/53	.877	
	Mental Abilities (B)	2/60	.325		2/53	.376	
	A × B	12/60	1.119		12/53	.896	
7 Mountains	Presentation Modes (A)	6/77	.753		6/72	.920	
	Mental Abilities (B)	2/77	5.820	< .01	2/72	3.296	< .05
	A × B	12/77	.631		12/72	.360	

TABLE 15

SUMMARY OF THE ANALYSIS OF VARIANCE FOR POSTTEST AND RETENTION TEST ON THE GENERALIZATION OBJECTIVE

Content	Source	Posttest			Retention Test		
		df	F	P	df	F	P
1 Thailand	Presentation Modes (A)	6/63	.645		6/54	.435	
	Mental Abilities (B)	2/63	1.238		2/54	2.504	< .10
	A × B	12/63	.612		12/54	1.367	
2 Irrigation	Presentation Modes (A)	6/67	2.336	< .05	6/65	3.714	< .01
	Mental Abilities (B)	2/67	8.122	< .01	2/65	12.413	< .01
	A × B	12/67	1.167		12/65	1.622	
3 India	Presentation Modes (A)	6/76	2.656	< .05	6/72	1.260	
	Mental Abilities (B)	2/76	1.529		2/72	3.012	< .05
	A × B	12/76	.438		12/72	.599	
4 Labor	Presentation Modes (A)	6/63	.319		6/58	1.271	
	Mental Abilities (B)	2/63	5.354	< .01	2/58	1.788	
	A × B	12/63	.947		12/58	.961	
5 Heat	Presentation Modes (A)	6/64	1.390		6/56	.883	
	Mental Abilities (B)	2/64	2.138		2/56	2.766	
	A × B	12/64	.589		12/56	.884	
6 Salamanders	Presentation Modes (A)	6/60	1.001		6/53	.659	
	Mental Abilities (B)	2/60	1.347		2/53	.192	
	A × B	12/60	.405		12/53	.941	
7 Mountains	Presentation Modes (A)	6/77	1.691		6/72	.640	
	Mental Abilities (B)	2/77	7.938	< .01	2/72	7.380	< .01
	A × B	12/77	.602		12/72	1.139	

TABLE 16

SUMMARY OF THE ANALYSIS OF VARIANCE FOR POSTTEST AND RETENTION TEST ON THE CLASSIFICATION OBJECTIVE

Content	Source	Posttest			Retention Test		
		df	F	P	df	F	P
1 Thailand	Presentation Modes (A)	6/63	2.009	< .10	6/54	2.631	< .05
	Mental Abilities (B)	2/63	5.250	< .01	2/54	2.327	< .10
	A × B	12/63	.606		12/54	1.052	
2 Irrigation	Presentation Modes (A)	6/67	.997		6/65	4.157	< .01
	Mental Abilities (B)	2/67	.862		2/65	3.630	
	A × B	12/67	.589		12/65	2.032	< .05
3 India	Presentation Modes (A)	6/76	1.501		6/72	.469	
	Mental Abilities (B)	2/76	.534		2/72	2.458	< .10
	A × B	12/76	.630		12/72	1.407	
4 Labor	Presentation Modes (A)	6/63	2.711	< .05	6/58	.821	
	Mental Abilities (B)	2/63	1.148		2/58	2.258	
	A × B	12/63	1.742		12/58	1.135	
5 Heat	Presentation Modes (A)	6/64	2.184		6/56	1.188	
	Mental Abilities (B)	2/64	2.921		2/56	1.126	
	A × B	12/64	1.496		12/56	1.743	< .10
6 Salamanders	Presentation Modes (A)	6/60	2.074	< .10	6/53	1.891	< .10
	Mental Abilities (B)	2/60	1.849		2/53	1.719	
	A × B	12/60	1.135		12/53	.751	
7 Mountains	Presentation Modes (A)	6/77	.342		6/72	1.418	
	Mental Abilities (B)	2/77	5.054	< .01	2/72	4.490	< .05
	A × B	12/77	1.703		12/72	.660	

Classification Objective

Only one significant presentation mode difference appeared in the posttest and it failed to reappear in the retention test for the content area Labor. In the content area Thailand the presentation mode F ratio did not quite reach significance in the posttest but did prove to be significant in the retention test at the .05 level. Also, in the content area Irrigation a similar significant presentation mode difference appeared in the retention test when it had not appeared in the posttest.

Two significant mental ability differences both reappeared in the retention test.

Conclusions

The results indicated that where significant differences occurred in the posttest analysis of variance, similar significant differences also appeared and/or diminished in the retention test analysis. The significant F ratios were carried over to the retention test for both presentation mode and mental ability variables. There were four exceptions to the above Finding where significant F ratios appear in the retention test but not in the posttest. These were found for presentation mode of Irrigation for the generalization and classification learning objective, the main variables in Irrigation in the retention test produced a significant interaction, and mental ability levels in India for the generalization objective.

In the three exceptions to post-retention test significant differences similarities, the high mental ability was responsible for producing significantly superior performance scores.

Thus, the main variables showed similar effect upon performance scores in both post and retention tests and therefore, hypothesis was supported in objectives and content areas with only four exceptions among the 42 comparisons.

Hypothesis Five

The single and multi-channel presentation modes produce significant differences in mean performance scores summed across mental ability levels for the population sampled for each content area and learning objective.

Results

The comparative effectiveness of single and multi-channel presentation modes are shown in Tables 17, 18, and 19.

Application Objective

Only one significant difference was found among the seven comparisons which indicated the multi-channel modes were significantly superior to the content area Thailand. While there appeared to be no other significant dif-

TABLE 17

COMPARISONS OF SINGLE (SC) AND MULTICHANNEL (MC) PRESENTATION MODES ON THE APPLICATION OBJECTIVE FOR EACH CONTENT AREA

Content	Mode	Rank	$\bar{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
1 Thailand	MC SC	1 2	7.500 7.042	1.320 1.202	36 48	82	MC > SC
2 Irrigation	MC SC	2 1	12.861 12.865	3.305 2.917	36 52	86	
3 India	MC SC	1 2	5.886 5.811	1.434 1.819	44 53	95	
4 Labor	MC SC	2 1	6.806 7.021	1.166 1.744	36 48	82	
5 Heat	MC SC	2 1	5.865 6.729	1.797 2.209	37 48	83	
6 Salamanders	MC SC	1 2	8.057 7.804	1.748 1.995	35 46	79	
7 Mountains	MC SC	1 2	11.897 11.678	2.161 2.417	39 59	96	

TABLE 18

COMPARISONS OF SINGLE (SC) AND MULTICHANNEL (MC) PRESENTATION MODES ON THE GENERALIZATION OBJECTIVE FOR EACH CONTENT AREA

Content	Mode	Rank	$\bar{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
1	MC	1	8.222	1.333	36	82	
Thailand	SC	2	8.083	1.622	48		
2	MC	1	14.694	2.376	36	86	MC > SC
Irrigation	SC	2	13.712	2.695	52		
3	MC	1	7.386	1.687	43	95	MC > SC
India	SC	2	6.509	1.659	53		
4	MC	1	8.417	1.421	36	82	
Labor	SC	2	8.208	2.113	48		
5	MC	1	7.000	2.185	37	83	
Heat	SC	2	6.729	1.807	48		
6	MC	1	10.829	1.580	35	79	
Salamanders	SC	2	10.283	2.344	46		
7	MC	1	12.205	2.408	39	96	
Mountains	SC	2	12.051	2.112	59		

TABLE 19

COMPARISONS OF SINGLE (SC) AND MULTICHANNEL (MC) PRESENTATION MODES ON THE CLASSIFICATION OBJECTIVE FOR EACH CONTENT AREA

Content	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
1 Thailand	MC SC	1 2	13.611 12.542	2.566 2.062	36 48	82	MC > SC
2 Irrigation	MC SC	1 2	4.806 4.519	1.635 1.638	36 52	95	
3 India	MC SC	1 2	11.364 10.547	2.438 1.977	44 53	95	MC > SC
4 Labor	MC SC	1 2	11.361 9.562	2.179 2.239	36 48	82	MC > SC
5 Heat	MC SC	1 2	13.892 13.208	2.480 2.369	37 48	83	
6 Salamanders	MC SC	1 2	4.914 4.109	1.868 1.566	35 36	79	MC > SC
7 Mountains	MC SC	2 1	5.846 5.847	1.424 1.323	39 59	96	

ferences the multi-channel modes appeared to produce higher performance scores.

Generalization Objective

The multi-channel modes produced two significant differences among the seven comparisons for this learning objective in the content areas Irrigation and India. Also, while not significantly better in the other five comparisons the multi-channel modes consistently ranked better than single channel modes.

Classification Objective

In four of seven single multi-channel mode comparisons, the multi-channel mode produced significant differences in content areas: Thailand, India, Labor and Salamanders. Also, while single channel modes did not produce significant mode differences the multi-channel consistently produced higher performance test scores.

Conclusions

The multi-channel presentation modes were found to be significantly superior to single multi-channel comparisons in seven cases of 21. Multi-channel mode superiority differences were found in increasing quantities from the application objective to the classification objective: one significant difference for application objective, two in generalization, and four in classification objective.

Examination of the posttest performance score means revealed that the general superiority of multi-channel modes, where significant, was approximately 1.2 performance score points better than single channel mode across the three learning objectives. The 21 single multi-channel comparisons revealed the multi-channel modes produced higher performance scores in all but two cases, although only seven were significantly better as reported above.

The superiority of the multi-channel modes was most apparent in the classification objective in four out of seven cases as shown in Table 19. Individual examination of the presentation mode performance score means for combined mental ability levels on the classification objective, Table 7, indicated a general performance score superiority for multi-channel modes. This superior performance score pattern for multi-channel modes on the classification objective also was shown when presentation modes were examined and compared on each mental ability level, Table 20.

The hypothesis was supported in one or more subject content areas in all three learning objectives. The type of learning activity involved in classification was definitely facilitated by multi-channel media presentations. Classification learning involved grouping stimuli on the basis of common attributes which multi-channel modes accomplished more effectively than single channel modes. In the application and generalization learning objectives

TABLE 20

SUMMARY OF SIGNIFICANT COMPARISONS AMONG PRESENTATION MODE MEANS FOR MENTAL ABILITY LEVELS

Content	M.A. Level	Duncan Multiple Range Test $\alpha = .05$
Application		
#4 Labor	High	(S > MpS)(Pr > PrS/Sp/Mp)
#3 India	High	Sp > Pr
#6 Salamanders	Med.	Pr > Mp/PrS/S
#1 Thailand	Med.	MpS > Pr
#5 Heat	Low	S > Pr/MpS/SpS
Generalization		
#7 Mountains	High	Mp > S
#3 India	High	MpS > S
#2 Irrigation	Low	MpS/Mp/SpS/Sp > Pr
Classification		
#5 Heat	High	SpS/Mp/SpS > PrS
#6 Salamanders	High	SpS > PrS/MpS/S
#3 India	High	SpS > Sp
#4 Labor	Med.	PrS/SpS > S/Sp
#7 Mountains	Med.	PrS > MpS
#4 Labor	Low	MpS/SpS > Mp
#5 Heat	Low	MpS/S/PrS > Sp
#7 Mountains	Low	Pr > S

multi-channel modes were generally superior than single channel modes, however, only significantly superior in three cases.

Hypothesis Six

The seven visual-verbal presentation modes will produce significant differences in mean performance scores on the three levels of mental ability for each content area and learning objective.

Results

Comparisons among presentation modes on mental ability levels, as shown in Appendix B and summarized in Table 20, revealed a total of 16 significant differences among the 63 comparisons.

Application Objective

Significant presentation mode differences were found on all three mental ability levels for the application objective. While there appears to be no significant pattern at particular levels, the spoken verbal, print and still picture modes appear to produce superior performance scores when compared to other modes on all three mental ability levels. The presentation mode producing significant differences on the high mental ability group also produced the same or similar results on the low mental ability group.

Generalization Objective

Although significant differences were found on all three mental ability levels, the same presentation mode, motion picture sound, was responsible for the significant difference on test performance.

In three cases the motion picture and motion picture with sound modes appeared to be significantly superior to other modes across levels of mental ability on the generalization objective; therefore, only limited evidence exists for a superior presentation mode on the generalization objective for any of the three mental ability levels.

Classification Objective

Eight significant presentation mode differences were found among the three mental ability levels. There appeared to be definite and specific presentation mode superiority evident depending upon mental ability level. The still picture with sound appeared to be superior mode in all three significant differences found at the high mental ability level. Print with sound was responsible for significant differences at the medium mental ability level, while motion picture with sound along with still picture with sound and print with sound modes produced the significant differences at the low mental ability. It appeared also that the spoken verbal or sound was a crucial factor in producing significant difference instance was a nonsound mode, print mode, found to produce superior results.

Conclusions

The hypothesis was supported in several instances in the 63 comparisons of presentation modes on three mental ability levels for each learning objective. However, there appeared to be little pattern to the significant presentation mode differences except on the classification objective. On the application and generalization objectives significantly superior presentation modes were similar regardless of the mental ability level, however on the classification level there appeared to be specific mode superiority by each level of mental ability. Learning of classifications was more effective on all three mental ability levels with the multi-channel presentation modes. Apparently, the nature of two sensory input channels allows the learner to determine more common attributes among stimuli in order to perform responses for classification objectives.

CHAPTER V

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

The purposes of the chapter are:

1. Review and summarize the problem of the study, review conclusions drawn from the literature, summarize the methodology utilized, and summarize the hypotheses.
2. Present the conclusions drawn from the data.
3. Discuss the conclusions on the main variables and instructional objectives under investigation.
4. Discuss the implications of the results for recommendations of further research and recommendations concerning implementation of the results.

Problem

Specific media characteristics and their capability to accomplish specific learning behaviors have not yet been identified. This exploratory study was an effort to identify unique media characteristics and their relationships to the specific learning objectives of classification, generalization and application. The specific objective of the study was to determine different verbal-visual presentation modes on three mental ability levels for three learning objectives.

Literature Summary

The review of media research contends that instructional efficiency can be affected by the relationship between instructional presentation mode or method and specific characteristics of the learner for specific learning objectives. The literature reviewed revealed three areas of major concern for media design research: (a) media characteristics in relation to learning; (b) the relationship of specific learning objectives and media; (c) media effects and specific learner characteristics. These three problem areas were the exploratory concern of this study.

The following conclusions were drawn from the literature reviewed:

1. Media taxonomies provided little practical or systematic guidelines for instructional media selection because uniform learning categories, media characteristics, or media-learner relationships have not been satisfactorily identified.

2. While there appeared to be scant evidence to support visual media in learning for the classification objective, the generalization and application media-learning objective relationships have received no research attention.

3. The research does suggest different learning effects depending upon presentation mode and mental ability

characteristics of the learner. This finding indicates that an interaction may take place between presentation mode and mental ability.

4. The multi-channel research appeared to favor multi-channel over single channel modes for the classification learning objective. The media channel literature does not provide any information for the generalization and application learning objectives.

5. The literature provides scant evidence for specific media category characteristics. With the exception of the motion variable in a visual media category and "information loaded" nature of visual which facilitates making relationships among elements for classification objectives, instructional media characteristics have not been identified.

6. There appeared to be no evidence to indicate that retention test performance scores, as a result of the presentation modes, would differ from those of the posttest.

Methodology

Design

The overall experimental design involved a randomized 3 x 7 analysis of variance design. The two independent variables were media presentation mode and mental ability for three learning objectives: classification, generalization and application. The subjects were fifth and sixth grade students randomly assigned to a single presentation mode followed by an immediate posttest and later a retention test.

Analysis of the data included analysis of variance for the main effects and interactions. Where significant differences were found a Duncan Multiple Range Test was used to determine which particular presentation mode contributed to the significance difference.

Population

Six hundred and seventeen fifth and sixth grade boys and girls were divided into three mental ability groups and then were randomly assigned to one of seven presentation modes. Approximately two weeks after the posttest a retention test was administered. From the original number of students tested, 576 of the students were present for the administration of the retention test.

Presentation Modes

The seven presentation modes were two motion picture modes which were similar except one had spoken verbal sound, two similar still picture modes except one carried spoken verbal narration, one mode which combined the spoken verbal narration and printed verbal narration, one mode which presented the printed version of the spoken verbal narration and one mode which presented the audio spoken verbal narration. Four modes were considered single channel modes: motion picture silent, still picture silent, printed words and spoken verbal because the learner was receiving stimuli through a single sensory channel. Three presentation modes were designated as multi-channel when the spoken verbal accompanied the motion picture, still picture, and printed word modes.

Experimental Materials

The stimulus materials included motion picture, 2 x 2 slides, audio tape and printed booklet. Seven existing commercially produced silent super 8mm motion pictures were selected for the study. Verbal narrations were developed for each subject content areas. The information carried by the presentation modes was identical within each subject content area, therefore the presentation mode varied but the information was the same.

Performance Tests

Seven performance tests were developed for the study, one test for each of the seven subject content areas. Each test included items for each of the three learning objectives: classification, generalization, and application. Two tryout phases were conducted to establish test procedures, make revisions and improve reliability of the tests.

The retention test was identical to the performance test a[illegible] put in printed booklet form, whereas the individual test items in the posttest were projected upon a screen.

Instrumentation

Super 8mm sound movie projectors, slide projectors, slide synchronizing cassette tape recorders were used for presenting stimuli in the presentation modes.

Preparation and Statistical Analysis of Data

All quantitative data were analyzed by computer. School district student data cards provided information on sex, grade, mental ability. Performance scores, presentation mode assigned subject content area assigned, and mental ability grouping data were added to the data card used in all analyses.

A two-way analysis of variance was used to simultaneously test several hypotheses. The analyses provided data on the main effects on presentation mode upon performance test scores, the main effect of mental ability upon performance test scores and the interaction effect of presentation mode and mental ability upon performance test scores. A Duncan Multiple Range Test was used to identify which particular mode or mental ability caused significant difference, $< .05$, among the independent variables.

Hypotheses Summary

Although the literature does not support superiority for any particular media presentation mode, it does suggest that differences in learning effectiveness will result among presentation modes for specific learning objectives and learner characteristics.

Therefore, the hypotheses were designed to determine:

1. Comparison of presentation modes for performance posttest learning effectiveness in each learning objective content area for the total population sampled.

2. Comparative learning effectiveness among three mental ability levels for each type of learning objective and content area.

3. Interaction of presentation mode with particular mental ability levels for each learning objective and content area.

4. The comparative presentation mode learning effectiveness between the posttest and retention test for presentation mode, mental ability levels and their interactions for each learning objective and content area.

5. The comparative learning effectiveness between single and multi-channel presentation modes.

6. The comparative learning effectiveness among presentation modes at each level of mental ability for each learning objective and content area.

Conclusions

The following conclusions are drawn from an analysis of the results:

1. One significant difference was found among the presentation mode variables on the application objective, two significant differences were found among modes for the generalization objective and one significant difference was found on the classification objective.

2. When the population was split into high, medium and low mental ability groups, significant differences in learning were found only for the high ability group: two on the application objective, three on the generalization, and two on the classification objective.

3. No significant differences were found as a result of the presentation mode and mental ability interactions.

4. The main variables produced the same effect upon performance scores in both post and retention tests in all cases except four of 63 comparisons of main variables and their interactions.

5. Single channel presentation modes were found to be superior to other modes for the application learning objective while multi-channel modes produce superior performance scores for the classification objective. Neither single or multi-channel modes were significantly superior on the generalization objective.

6. While several significant differences were found among presentation modes at each mental ability level, there was no pattern across mental ability level or learning objective. Thus, no conclusions can be drawn for a superior presentation mode on particular mental ability levels. However, the analysis does confirm the conclusion drawn above concerning a definite superiority for various presentation modes depending upon the learning objective.

Discussion, Implications, and Recommendations

The results support and extend the research findings concerning media-learning objective relationships. Possible differential learning effects as a result of the seven different presentation modes on three mental ability levels did not generally materialize for the generalization or application learning objectives. However, the reverse was found for the classification learning objective. Several significant differences, at the $< .05$ level, among presentation modes indicated particular modes were superior in their ability to produce superior test performance on the classification learning objective.

Analysis of the results also revealed specific media superiorities when the presentation modes were compared across the three learning objectives: classification, generalization and the application of learning. In other words, one particular mode produced superior test results on the application objective while another presentation mode produced superior test results on the classification objective.

These findings support Gagné's (1965) conclusions which suggest that different stimuli are required for reproductive and constructive learning tasks. This experiment also attempted to divide concept learning into component learning tasks of classification, generalization, and application. The results did indicate, as Gagné suggested, that different mental operations were required of students depending upon the learning tasks.

Learning Objectives

A careful analysis of the literature on learning hierarchies and their role in the development of presentation sequences can be summarized as follows: there are no well-defined guidelines for producing learning hierarchies; the relationship between the structure of knowledge and the associated learning hierarchy has not yet been adequately researched; and the role of learning hierarchies in the development of presentation sequence or modes is unclear (Gagné, 1967,1968; Gagné, Paradise, 1961; Merrill, 1965; Briggs, 1968).

The results of this study, however, suggested that particular presentation modes were effective at various learning objective levels arranged in a hierarchy. There appeared to be a definite progression in the simplicity of the presentation mode in facilitating learning from the classification objective compared to the application objective. While the problem of determining student past experience in making generalizations and the application of learning is not clear, there appeared to be a relationship because superior significant presentation mode differences on these two learning objectives were generally found only for the high mental ability groups.

The results, although limited, cast doubt on some aspects of past research concerning the unique contributions of media-learning objective relationships. A recent media taxonomy (Allen, 1967) suggested multi-channel modes facilitated the learning of principles, concepts and rules. The results did not support this theory for the generalization or application objectives; however the theory was supported by the results for the classification objective. Therefore, additional research is needed to replicate these findings or determine presentation stimuli necessary for reproductive types of learning. It must be noted, however, that previous definitions of these learning types were not identical to the learning types in the experiment.

Additional research is required to determine adequate testing procedures for generalizing and the application of learning. Different patterns of presentation need to be investigated, i.e., scrambled, sequential, and simultaneous methods because there appears to be doubt concerning the adequacy of a linear presentation of the content for the generalization and application objectives.

As explained in Chapter I, this study was part of a larger study and the resulting stimulus materials were designed to teach five learning objectives for "low" level learning of identifications or recall to the "high" level application of learning. The original seven subject content area films selected were adapted for the study and the films basically presented the content in a linear and sequential manner. The content of the films was further adapted to all the presentation modes which gave this same characteristic to each mode. The literature suggests that the media design should be unique for each type of learning objective, in other words, the structure of a visual presentation would be designed differently for the learning of identifications than for learning of classifications among stimuli.

The results of the multi-channel modes suggest a rationale for the occurrence of more significant differences found on the classification learning objective while fewer significant findings were found at the "higher" learning objective levels of generalization and application. Simply stated, a linear or sequential presentation of content may not produce effective learning at the generalization or application learning levels. The single channel modes or print and spoken verbal modes, while presented sequentially, allow the learner to process information "more freely" than the visual modes.

Another possible explanation could possibly be found in the testing procedure. Gagné (1963, p. 624) hypothesized that "an individual will not be able to learn a particular topic if he has failed to achieve any of the subordinate topics that support it." The students were tested for all learning objectives after presentation of the stimulus. The questions were given on the application level first followed by generalization and classification questions. This procedure attempted to reduce carryover or cueing from one learning objective question to another. Therefore, this procedure does not facilitate a determination on the mastery of tasks at lower levels before attempting more difficult or higher learning objective questions.

Another possible explanation for the small number of significant mode differences at the generalization and application levels was the students' past experiences in performing these mental operations. Classification of stimuli is a much more common learning task than the application of learning in the fifth and sixth grade curricula, therefore a wider variance or significant differences on the classification learning objective.

Application Objective

Only the spoken verbal and print modes were found to be significantly superior among the presentation modes for this objective. These same modes did not produce significant results on any of the other learning objectives. This possibly suggests that less concrete referents or stimuli, as opposed to the visual mode, provided less "mental interference" in the application of learning.

In the sixth hypothesis the presentation modes were compared on each mental ability level and the results were similar to the findings described above. There appeared to be no specific presentation mode superiority at a particular mental ability level. However, the print and spoken verbal modes produced the superior significant differences regardless of mental ability level. Therefore, there appeared to be limited but conclusive evidence to support the contention that presentation stimuli produce various learning effectiveness depending upon the learning objective.

Generalization Objective

Two significantly superior differences among presentation modes were found for this learning objective. Print with spoken verbal and still picture, with spoken verbal, and motion picture with spoken verbal modes accounted for the significantly superior mode differences.

There was a similarity in the definition of the generalization and classification learning objectives, therefore some similarity in the presentation modes which produced significant differences. While a minor similarity did occur between learning tasks, the presentation mode differences are generally unique to particular learning objectives. The results of hypothesis six also confirm like findings; and the motion picture with spoken verbal produced superior significant differences on both high and low mental ability levels. Therefore, the limited evidence suggests that a visual and spoken verbal or multi-channel facilitates the process of generalizing.

Classification Objective

A single significant superior mode difference was found on the classification objective. However, its interpretation supports specific and unique presentation modes for particular learning objectives. The motion and still picture modes with spoken verbal were found to produce significantly superior test performance scores. Up to this point in the discussion all superior mode differences were unique to a learning objective. Motion picture with spoken verbal also produced a significant difference on the generalization objective, however, as explained under the previous section, the reason may be the similarity in mental process. The still picture with spoken verbal was found to produce superior test results only on the classification objective. On the other two learning objectives neither the print nor spoken verbal modes produced significant differences. Therefore, there appeared to be limited but conclusive evidence to support the contention that presentation stimuli produce various learning effectiveness depending upon the learning objective.

When significant mode differences were analyzed on each of the mental ability levels, there appeared to be unique mode superiority for each mental ability level. In general, the still picture mode with spoken verbal mode produced superiority at the high mental ability level, print with spoken verbal at the medium mental ability level and the motion picture with spoken verbal at the low mental ability level. The important factor in the interpretation was the fact that all significant modes were multi-channel. This finding supports the work of May (1965) and Allen (1964) in which they explained the role of visuals in facilitating relationships among aspects of the visual.

There were few significantly superior findings among presentation modes within the three learning objectives; however, definite differences among modes were apparent when compared across learning objectives. For the more abstract learning tasks of application the single channel modes were superior to the multi-channel modes. However, for the generalization and classification objective the reverse was found, the multi-channel modes producing superior test performance. This finding supports Gagné's (1965) work in which he suggests media stimuli and responses for reproductive learning objectives are different from those required for the learning of concepts, principles and problem solving.

Single and Multi-channel Modes

The results do not support the work of Travers (1966) who cast doubt on the superiority of multi-channel modes. However, Travers does not include the learning objectives of generalization and application. On the other hand there appears to be substantial evidence to support Conway (1967), Hartman (1961a) and Hsia (1968). These three researchers suggest that multi-channels provide more cues and thus increase the possibilities of generalizing among cues for classification learning objectives. While this was generally found to be correct from the results for the classification objective, it did not prove to be the case with the application learning objective.

The results did support the literature which suggested that multi-channel presentation modes were superior to single channel modes for a wider range of mental ability. The results indicated that multi-channel modes produced significant differences regardless of mental ability level.

Mental Ability Variable

The results concerning media-learner characteristic relationships did not support the previous but limited research. There appeared to be little evidence to suggest that particular presentation modes would produce superior test performance depending upon mental ability level of the students.

The fact that the mental ability of the subjects was related to the performance scores but unrelated to the presentation mode does not conform to the predictions based upon the literature. The findings are more in accord with the previous research of Gagné and Gropper (1965) and Allen, Filep and Cooney (1967) when they found no correlation between learner aptitudes and visual presentation modes.

Conclusion

The study has demonstrated the effectiveness of particular presentation stimuli in teaching three types of learning objectives. This implies that when specific types of learning can be identified particular presentation modes will produce superior learning effectiveness. The exact conditions under which particular modes should be specified is unclear because the results were limited and findings need to be replicated.

This study also points out the need for clear, concise, and specific learning objectives before a media stimuli taxonomy will be useful in the design of instructional materials.

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APPENDIXES

APPENDIX A

POSTTEST PERFORMANCE MEANS AND STANDARD DEVIATIONS ON PRESENTATION MODES
BY MENTAL ABILITY LEVEL ON THE APPLICATION OBJECTIVE

		MpS			Mp			SpS			Sp			PrS			Pr			S		
		N	$\overline{X}$	σ	N	$\overline{X}$	σ	N	$\overline{X}$	σ	N	$\overline{X}$	σ	N	$\overline{X}$	σ	N	$\overline{X}$	σ	N	$\overline{X}$	σ
1 Thailand	High	4	7.500	2.645	4	7.000	1.414	4	7.250	1.258	4	5.750	.957	4	7.750	.957	4	7.000	.816	4	7.500	1.290
	Med.	4	8.500	1.914	4	7.500	.577	4	7.500	.577	4	6.500	1.000	4	6.750	1.707	4	6.250	.957	4	8.250	1.258
	Low	4	8.000	.816	4	7.000	1.414	4	7.250	.500	4	7.000	1.632	4	7.000	.000	4	7.750	1.258	4	7.000	.816
2 Irrigation	High	4	15.25	1.892	4	15.75	2.061	4	13.50	3.316	4	13.25	2.061	4	13.00	3.464	4	15.25	1.707	5	13.00	1.414
	Med.	4	11.75	3.201	7	15.00	3.109	4	11.50	5.196	4	11.25	2.872	4	11.25	2.629	4	10.50	2.380	4	12.00	2.943
	Low	4	14.50	3.109	4	12.25	1.892	4	13.75	4.500	4	10.75	2.061	4	11.25	1.707	4	10.75	2.872	4	13.00	4.320
3 India	High	4	6.000	.816	6	5.500	1.224	4	6.250	.957	4	6.750	1.707	3	6.333	2.081	4	4.500	1.290	4	5.000	1.414
	Med.	6	5.333	1.751	6	6.633	1.366	6	4.833	1.834	4	6.000	1.154	4	7.000	1.414	4	5.000	3.366	4	6.750	2.217
	Low	7	5.857	1.069	6	5.833	2.401	7	6.285	.951	3	6.666	.577	3	5.666	2.081	4	4.500	1.914	4	7.000	1.414
4 Labor	High	4	7.000	.816	4	5.500	1.732	4	7.000	.816	4	6.250	1.500	4	6.500	1.914	4	8.750	1.258	4	8.000	1.154
	Med.	4	6.50	1.732	4	6.250	.957	4	7.000	.000	4	5.750	1.707	4	7.000	.816	4	7.500	1.290	4	8.250	1.707
	Low	4	6.000	1.154	4	7.250	2.217	4	6.500	.577	4	6.500	1.290	4	7.750	1.707	4	6.750	1.892	4	7.500	2.380
5 Heat	High	4	5.500	1.732	5	6.200	1.923	4	5.250	2.217	4	6.500	3.511	4	4.500	1.000	4	7.000	1.414	4	7.000	2.160
	Med.	4	7.500	1.00	4	6.000	2.449	4	7.250	2.061	4	6.000	3.265	5	6.200	1.095	4	6.750	.500	4	7.250	2.753
	Low	4	5.000	1.414	4	6.750	2.061	4	4.500	.577	3	6.666	2.309	4	7.000	2.449	4	5.250	1.892	4	9.500	1.000
6 Salamanders	High	4	13.750	.957	4	12.500	2.380	3	14.333	2.081	4	12.750	3.947	4	11.500	2.645	6	12.500	1.760	4	13.750	.957
	Med.	4	11.500	1.290	5	11.60	3.049	4	12.500	1.732	4	11.500	2.380	4	10.500	2.872	6	11.166	2.136	5	11.200	1.923
	Low	6	11.16	1.471	5	10.80	3.898	6	11.666	2.338	4	9.750	1.707	4	11.500	2.516	6	12.333	1.632	6	10.666	2.160
7 Mountains	High	4	9.250	2.217	4	6.000	2.160	4	7.750	1.707	3	6.000	3.000	4	7.750	1.707	5	9.000	2.000	4	8.000	1.414
	Med.	4	8.500	2.516	4	7.500	2.380	4	8.250	1.500	3	7.666	2.081	3	7.333	1.154	4	10.500	1.000	4	7.000	1.414
	Low	4	6.750	.957	4	7.500	1.732	4	7.750	1.892	4	8.000	1.632	4	9.000	1.825	3	8.000	2.000	4	7.750	.957

POSTTEST PERFORMANCE MEANS AND STANDARD DEVIATIONS ON PRESENTATION MODES
BY MENTAL ABILITY LEVEL ON THE GENERALIZATION OBJECTIVE

		MpS			Mp			SpS			Sp			PrS			Pr			S		
		N	$\bar{X}$	σ	N	$\bar{X}$	σ	N	$\bar{X}$	σ	N	$\bar{X}$	σ	N	$\bar{X}$	σ	N	$\bar{X}$	σ	N	$\bar{X}$	σ
1 Thailand	High	4	8.500	4.290	4	7.500	.577	4	9.250	1.258	4	8.750	2.500	4	8.250	1.707	4	8.250	2.217	4	9.000	1.632
	Med.	4	8.250	1.258	4	8.500	2.645	4	8.000	.000	4	8.000	1.414	4	8.000	.816	4	6.750	1.500	4	9.000	2.160
	Low	4	7.500	1.914	4	8.250	1.500	4	8.500	1.732	4	7.250	.500	4	7.750	1.707	4	8.000	.816	4	7.750	.957
2 Irrigation	High	4	15.00	1.414	4	15.75	3.403	4	15.00	2.943	4	15.00	1.414	4	17.00	2.160	4	16.75	2.362	5	14.20	3.114
	Med.	4	14.50	3.000	7	14.00	2.708	4	14.50	2.645	4	14.25	1.500	4	12.75	3.304	4	11.25	1.707	4	11.75	1.500
	Low	4	14.50	1.732	4	14.50	2.516	4	14.50	2.081	4	14.25	.500	4	14.50	1.914	4	11.00	2.581	4	11.50	2.081
3 India	High	4	8.750	2.217	6	7.333	2.065	4	7.250	.500	4	6.250	1.500	3	8.000	2.000	4	7.250	.957	4	5.500	1.914
	Med.	6	7.000	1.673	6	7.333	.817	6	7.500	2.073	4	5.500	1.732	4	7.500	1.914	4	7.250	2.629	4	6.500	1.000
	Low	7	6.714	1.253	6	7.166	1.169	7	7.285	2.138	3	5.666	1.527	3	7.333	1.154	4	5.500	1.000	4	5.500	2.380
4 Labor	High	4	9.500	1.000	4	9.000	2.449	4	8.250	1.500	4	9.000	.000	4	9.500	.577	4	9.500	1.732	4	9.500	1.732
	Med.	4	8.500	1.732	4	7.750	1.258	4	8.750	1.258	4	7.750	2.500	4	9.000	.816	4	7.000	3.464	4	8.250	2.362
	Low	4	8.250	.500	4	7.000	2.309	4	7.000	1.825	4	7.250	2.500	4	7.000	1.414	4	9.250	1.892	4	7.250	1.707
5 Heat	High	4	8.250	2.061	5	8.200	.836	4	6.750	3.304	4	6.500	1.732	4	8.500	3.316	4	6.250	.500	4	7.500	2.380
	Med.	4	6.500	2.081	4	6.500	1.732	4	5.500	1.732	4	7.000	1.825	5	7.400	1.140	4	6.250	2.061	4	7.250	1.707
	Low	4	5.750	1.258	4	6.500	1.000	4	7.500	.577	3	5.000	1.732	4	6.750	2.986	4	5.250	2.629	4	7.750	2.217
6 Salamanders	High	4	13.500	2.380	4	15.000	1.414	3	13.333	2.081	4	13.000	.817	4	12.500	2.380	6	13.166	1.329	4	10.750	1.500
	Med.	4	12.500	.577	5	12.400	1.673	4	14.000	2.000	4	12.250	1.892	4	11.500	2.081	6	13.166	1.722	5	11.200	2.489
	Low	6	11.000	2.190	5	11.400	1.140	6	12.000	3.741	4	9.750	.957	4	10.500	1.914	6	11.333	1.751	6	11.166	3.311
7 Mountains	High	4	9.750	1.707	4	10.000	2.160	4	11.000	1.154	3	8.000	4.582	4	10.750	2.500	5	10.200	2.387	4	10.000	1.414
	Med.	4	10.750	2.872	4	10.250	2.872	4	11.250	.957	3	10.000	3.605	3	10.666	2.081	4	11.000	1.632	4	12.000	2.309
	Low	4	11.250	.500	4	10.750	1.707	4	10.500	1.290	4	9.500	1.000	4	11.500	1.000	3	12.000	2.645	4	9.500	2.380

POSTTEST PERFORMANCE MEANS AND STANDARD DEVIATIONS ON PRESENTATION MODES
BY MENTAL ABILITY LEVEL ON THE CLASSIFICATION OBJECTIVE

		MpS			Mp			SpS			Sp			PrS			Pr			S		
		N	$\bar{X}$	σ	N	$\bar{X}$	σ	N	$\bar{X}$	σ	N	$\bar{X}$	σ	N	$\bar{X}$	σ	N	$\bar{X}$	σ	N	$\bar{X}$	σ
1 Thailand	High	4	15.500	2.645	4	13.500	1.732	4	15.250	1.500	4	13.250	1.258	4	14.500	.577	4	13.750	2.217	4	13.000	2.160
	Med.	4	13.000	2.160	4	13.500	1.914	4	13.500	1.000	4	12.250	1.500	4	13.000	3.915	4	11.250	1.707	4	12.250	2.872
	Low	4	12.750	2.753	4	14.000	1.414	4	12.000	.816	4	10.500	2.516	4	13.000	4.760	4	10.500	1.732	4	12.750	1.500
2 Irrigation	High	4	5.500	.577	4	5.500	1.732	4	5.250	3.201	4	4.250	2.061	4	3.750	1.892	4	6.250	.500	5	4.400	2.073
	Med.	4	4.750	1.258	7	4.571	1.718	4	4.750	1.892	4	3.750	1.707	4	5.500	1.732	4	4.000	1.414	4	4.000	1.414
	Low	4	4.750	.500	4	5.250	1.707	4	4.750	.957	4	3.500	1.290	4	4.250	2.061	4	4.750	1.707	4	4.000	1.632
3 India	High	4	11.750	2.872	6	10.666	2.943	2	13.000	2.000	4	8.750	2.629	3	10.666	1.154	4	12.500	2.081	4	11.000	1.632
	Med.	6	11.000	1.788	6	10.666	4.131	6	12.166	2.401	4	9.750	3.201	4	9.250	.957	4	10.000	1.632	4	11.000	2.449
	Low	7	11.428	2.299	6	10.833	2.136	7	11.285	1.253	3	10.666	2.516	3	11.333	1.527	4	9.500	1.290	4	11.000	.817
4 Labor	High	4	12.750	.957	4	10.000	2.943	4	10.250	2.500	4	10.250	1.250	4	9.750	1.500	4	10.250	1.892	4	11.000	2.449
	Med.	4	10.250	2.217	4	10.250	.957	4	12.500	1.000	4	8.250	2.061	4	12.750	1.258	4	10.250	.957	4	9.000	3.162
	Low	4	12.500	1.000	4	7.250	2.362	4	12.500	2.886	4	9.250	3.304	4	9.000	2.160	4	9.750	2.986	4	9.250	1.258
5 Heat	High	4	16.250	1.258	5	15.400	2.302	4	15.250	.957	4	14.750	1.258	4	11.500	3.415	4	13.750	1.892	4	13.000	3.366
	Med.	4	12.000	3.559	4	13.500	1.290	4	15.000	1.825	4	13.000	3.366	5	13.400	2.073	4	12.500	1.000	4	13.250	2.872
	Low	4	13.250	2.061	4	12.750	1.892	4	14.750	1.500	3	9.666	1.154	4	13.750	2.362	4	12.000	2.708	4	13.500	1.732
6 Salamanders	High	4	4.000	1.414	4	4.750	1.258	4	6.500	1.732	3	4.666	1.154	4	4.250	.957	5	6.000	1.581	4	4.000	.816
	Med.	4	5.750	1.258	4	4.500	1.290	4	5.500	2.081	3	3.000	2.645	3	5.000	2.000	4	3.000	.816	4	3.250	1.500
	Low	4	4.750	3.304	4	3.750	1.500	4	5.000	1.825	4	4.000	2.160	4	3.500	1.290	3	4.333	1.154	4	3.500	1.290
7 Mountains	High	4	6.750	.500	4	6.250	.957	3	6.000	1.000	4	6.000	1.154	4	6.250	1.500	6	5.833	1.471	4	6.500	1.290
	Med.	4	5.000	1.825	5	5.600	1.140	4	6.250	.957	4	6.250	.957	4	7.000	.817	6	6.000	1.264	5	6.600	.894
	Low	6	5.666	1.632	5	5.200	1.095	6	4.833	1.722	4	5.750	1.500	4	5.500	1.290	6	6.666	.516	6	4.000	1.673

RETENTION TEST PERFORMANCE MEANS AND STANDARD DEVIATIONS ON PRESENTATION MODES BY MENTAL ABILITY LEVEL ON THE APPLICATION OBJECTIVE

		MpS			Mp			SpS			Sp			PrS			Pr			S		
		N	$\bar{X}$	σ	N	$\bar{X}$	σ	N	$\bar{X}$	σ	N	$\bar{X}$	σ	N	$\bar{X}$	σ	N	$\bar{X}$	σ	N	$\bar{X}$	σ
1 Thailand	High	4	7.000	.816	4	6.500	1.732	3	7.000	1.000	4	6.500	.577	4	8.500	1.290	2	8.500	.707	4	8.000	.816
	Med.	4	8.000	.816	4	7.500	.577	3	7.666	.577	4	7.000	.816	3	8.000	1.732	4	7.250	.957	4	7.500	1.000
	Low	2	8.000	.000	4	7.250	1.707	4	7.000	.816	3	7.333	1.527	3	7.333	1.527	4	8.000	1.875	4	8.250	.500
2 Irrigation	High	3	16.666	2.081	4	16.250	2.061	4	15.500	1.732	4	14.750	4.193	4	15.250	1.892	4	15.500	1.290	4	13.250	2.061
	Med.	5	13.800	4.086	7	15.000	3.651	4	16.500	4.358	3	14.000	3.605	4	12.000	1.632	4	11.750	2.629	5	11.600	2.607
	Low	4	16.250	2.217	4	14.000	2.828	4	16.750	2.217	4	13.750	1.892	3	14.000	1.000	4	12.000	3.829	4	15.750	2.061
3 India	High	4	7.250	.500	5	6.000	1.000	4	6.750	2.500	4	5.500	1.000	3	3.666	1.154	4	5.500	2.516	4	6.250	2.217
	Med.	6	5.666	1.632	6	6.500	.836	6	5.666	1.751	4	6.000	2.309	4	5.250	1.500	4	6.250	2.217	4	5.500	2.380
	Low	7	5.714	1.380	5	7.600	1.516	7	6.857	2.267	3	6.666	2.081	2	5.000	1.414	3	6.333	2.081	4	7.750	.500
4 Labor	High	3	5.333	1.527	4	6.250	1.707	4	6.000	1.414	3	7.000	1.000	4	7.000	1.414	3	8.000	2.645	4	14.500	8.698
	Med.	3	7.333	.577	4	7.250	1.258	4	6.750	.500	4	7.000	.816	4	6.750	1.707	4	8.750	.957	4	10.500	7.937
	Low	4	6.250	1.500	4	6.250	2.362	4	7.500	.577	4	7.000	2.449	4	11.500	7.325	4	10.250	8.098	3	6.666	1.527
5 Heat	High	4	8.500	1.732	5	6.200	2.774	3	5.333	1.154	2	4.500	.707	4	5.250	2.629	3	7.333	1.527	4	7.750	1.500
	Med.	4	7.750	1.258	4	7.500	3.000	4	8.250	.957	4	5.750	2.629	5	7.200	3.033	4	7.750	1.892	3	7.666	3.214
	Low	3	7.333	3.055	3	8.333	1.527	4	4.000	1.154	3	7.000	2.645	3	7.333	2.309	3	4.666	2.081	5	7.000	3.240
6 Salamanders	High	4	8.750	2.500	4	9.000	3.741	4	7.750	1.892	3	7.000	2.645	3	10.333	2.309	5	7.600	1.140	3	9.000	1.732
	Med.	4	8.750	.500	4	9.750	2.986	3	6.333	2.081	4	8.250	1.500	3	6.666	3.214	4	8.500	1.000	3	8.333	.577
	Low	4	8.750	1.892	3	7.666	2.081	4	8.250	.500	5	8.600	1.516	2	8.500	.707	3	7.666	1.527	2	10.000	.000
7 Mountains	High	4	13.750	.957	4	13.750	1.892	2	14.500	2.421	4	12.750	1.258	3	12.000	2.000	5	12.000	2.000	4	13.250	.957
	Med.	4	17.250	1.258	5	11.800	2.489	4	12.250	2.061	4	11.000	2.000	4	11.250	1.707	6	11.500	1.974	5	12.000	4.472
	Low	6	12.666	2.250	5	11.000	2.236	5	12.400	2.408	4	10.500	3.696	4	12.000	1.154	6	12.333	1.966	5	11.600	1.949

RETENTION TEST PERFORMANCE MEANS AND STANDARD DEVIATIONS ON PRESENTATION MODES
BY MENTAL ABILITY LEVEL ON THE GENERALIZATION OBJECTIVE

		MpS			Mp			SpS			Sp			PrS			Pr			S		
		N	$\overline{X}$	σ	N	$\overline{X}$	σ	N	$\overline{X}$	σ	N	$\overline{X}$	σ	N	$\overline{X}$	σ	N	$\overline{X}$	σ	N	$\overline{X}$	σ
1 Thailand	High	4	6.500	1.732	4	8.750	.500	3	9.000	1.000	4	9.500	2.380	4	8.500	1.732	2	8.000	.000	4	8.500	2.082
	Med.	4	8.500	2.380	4	7.500	2.516	3	8.000	1.000	4	7.000	2.449	3	6.666	1.528	4	7.750	1.500	4	8.250	.957
	Low	2	8.500	.707	4	9.250	1.500	4	9.250	1.500	3	8.333	.577	3	9.000	.000	4	8.750	.957	4	6.250	2.217
2 Irrigation	High	3	16.333	2.517	4	17.500	1.240	4	16.250	2.217	4	14.250	1.707	4	15.750	3.593	4	16.250	.957	4	14.000	2.943
	Med.	5	15.200	1.789	7	14.429	2.299	4	16.500	1.000	3	14.666	2.886	4	11.500	3.109	4	13.000	.816	5	11.000	1.414
	Low	4	14.500	.577	4	12.500	3.416	4	14.250	2.753	4	13.250	2.629	3	11.000	2.000	4	10.750	1.707	4	13.750	1.258
3 India	High	4	7.000	2.943	5	7.400	2.073	4	8.250	1.258	4	7.250	1.238	3	8.666	1.527	4	8.000	1.414	4	8.500	1.000
	Med.	6	6.833	1.169	6	7.500	1.974	6	8.166	.752	4	5.750	1.707	4	7.250	2.217	4	7.000	2.581	4	6.750	2.753
	Low	7	7.142	1.214	5	6.200	1.483	7	6.714	1.603	3	5.666	2.516	2	8.500	2.121	3	7.000	1.732	4	6.000	.816
4 Labor	High	3	8.333	2.081	4	7.500	3.109	4	8.250	1.707	3	10.000	1.000	4	7.500	1.290	3	8.000	1.732	4	11.250	.957
	Med.	3	6.666	2.309	4	6.750	7.707	4	7.750	2.362	4	8.000	1.414	4	9.500	1.290	4	8.500	2.380	4	10.000	2.160
	Low	4	7.500	1.914	4	6.250	1.500	4	8.250	2.362	4	7.250	2.061	4	8.250	2.986	4	8.750	2.753	3	7.000	2.645
5 Heat	High	4	8.250	1.500	5	8.200	.836	3	7.666	1.527	2	7.000	1.414	4	7.000	2.160	3	6.666	1.527	4	6.750	2.753
	Med.	4	5.750	.957	4	6.000	1.414	4	9.750	2.872	4	6.250	1.258	5	5.800	1.095	4	7.000	1.825	3	7.666	.577
	Low	3	6.000	1.732	3	7.000	1.000	4	6.500	1.290	3	4.666	1.154	3	6.333	2.886	3	6.333	2.081	5	8.000	2.549
6 Salamanders	High	4	9.500	.577	4	10.500	1.914	4	9.500	1.290	3	7.666	2.516	3	11.000	1.732	5	9.600	2.073	3	9.666	4.725
	Med.	4	10.500	5.000	4	9.000	1.154	3	10.666	.577	4	9.500	1.732	3	10.666	2.081	4	9.500	2.380	3	10.333	1.527
	Low	4	11.500	1.290	3	8.666	2.309	4	7.250	2.362	5	10.400	2.509	2	9.000	2.828	3	10.666	1.154	2	11.500	.707
7 Mountains	High	4	14.000	2.449	4	13.750	1.258	2	14.500	2.121	4	15.250	.957	3	12.333	5.507	5	13.800	2.167	4	12.000	2.878
	Med.	4	12.750	2.362	5	12.200	2.387	4	3.750	2.872	4	9.500	1.290	4	12.250	.957	6	11.000	1.673	5	11.600	1.673
	Low	6	10.833	1.722	5	10.800	3.563	5	11.400	1.816	4	11.500	3.415	4	11.750	1.500	6	11.500	1.378	5	11.000	3.872

RETENTION TEST PERFORMANCE MEANS AND STANDARD DEVIATIONS ON PRESENTATION MODES
BY MENTAL ABILITY LEVEL ON THE CLASSIFICATION OBJECTIVE

		MpS			Mp			SpS			Sp			PrS			Pr			S		
		N	$\overline{X}$	σ	N	$\overline{X}$	σ	N	$\overline{X}$	σ	N	$\overline{X}$	σ	N	$\overline{X}$	σ	N	$\overline{X}$	σ	N	$\overline{X}$	σ
1 Thailand	High	4	14.750	3.304	4	12.250	1.707	3	15.333	1.527	4	12.250	1.500	4	11.250	2.872	2	11.500	.707	4	10.500	2.081
	Med.	4	12.750	2.872	4	11.750	2.986	3	12.666	2.309	4	11.500	1.290	3	11.333	3.214	4	11.250	2.872	4	10.000	2.581
	Low	2	13.000	.000	4	11.750	1.707	4	11.000	1.414	3	9.000	2.645	3	12.333	2.516	4	8.000	2.943	4	12.250	1.892
2 Irrigation	High	3	6.000	.000	4	5.500	1.290	4	7.000	.816	4	5.000	1.414	4	3.250	2.986	4	6.500	1.000	4	4.750	1.258
	Med.	5	3.800	1.095	7	5.714	1.704	4	5.500	7.380	3	5.666	1.527	4	4.500	1.732	4	3.250	1.707	5	4.600	1.516
	Low	4	5.000	.816	4	5.750	.957	4	5.750	1.258	4	3.000	1.414	3	4.000	1.000	4	3.750	.500	4	3.250	.500
3 India	High	4	10.500	2.081	5	9.800	3.114	4	12.500	1.000	4	12.500	1.732	3	12.666	1.527	4	13.250	1.707	4	11.500	3.696
	Med.	6	9.333	1.632	6	11.000	2.449	6	10.833	1.471	4	11.250	2.629	4	11.250	.957	4	11.250	2.629	4	9.750	3.593
	Low	7	12.857	1.573	5	9.600	1.516	7	9.428	2.760	3	11.333	3.785	2	11.000	2.828	3	8.666	.577	4	9.750	4.500
4 Labor	High	3	15.666	1.154	4	11.250	2.061	4	11.000	1.414	3	11.333	1.527	4	10.000	2.828	3	10.000	1.000	4	14.000	3.559
	Med.	3	10.666	.577	4	10.500	1.914	4	11.000	2.000	4	10.500	1.290	4	10.750	2.986	4	8.250	2.629	4	10.000	3.773
	Low	4	11.500	1.914	4	8.750	2.362	4	9.000	1.414	4	10.250	7.753	4	11.750	2.217	4	11.000	4.690	3	8.666	1.154
5 Heat	High	4	16.250	1.500	4	14.200	2.588	3	13.000	1.732	2	15.500	.707	4	13.000	2.943	3	9.000	4.582	4	13.000	4.242
	Med.	4	12.750	5.560	4	13.750	1.500	4	12.000	2.160	4	13.500	2.081	5	12.800	2.049	4	14.500	.577	3	10.333	2.516
	Low	3	13.333	2.081	3	11.666	2.081	4	12.000	2.828	3	8.666	1.527	3	15.000	2.645	3	11.333	1.527	5	13.400	3.646
6 Salamanders	High	4	5.250	1.258	4	3.500	1.290	4	5.750	2.061	3	4.333	1.154	3	3.666	2.516	5	6.200	1.303	3	3.666	.577
	Med.	4	5.500	1.732	4	4.250	2.217	3	5.333	1.154	4	3.500	2.516	3	5.000	2.000	4	3.750	2.217	3	4.000	1.000
	Low	4	4.250	3.304	3	2.666	2.516	4	5.000	.816	5	4.400	1.516	2	2.500	.707	3	4.333	.577	2	2.500	.707
7 Mountains	High	4	6.750	.957	4	6.500	1.290	2	7.000	.000	4	6.500	1.000	3	7.000	1.000	5	6.000	1.000	4	6.750	.957
	Med.	4	6.750	.957	5	6.400	1.516	4	6.500	1.000	4	6.500	1.000	4	7.250	.500	6	6.333	1.211	5	5.000	1.220
	Low	6	6.500	1.048	5	5.000	1.414	5	5.800	1.095	4	5.250	.957	4	6.000	2.000	6	6.333	.816	5	4.400	3.646

APPENDIX B

COMPARISON OF PRESENTATION MODE MEANS FOR HIGH, MEDIUM AND LOW MENTAL ABILITIES FOR THE APPLICATION OBJECTIVE
(Thailand)

M.A. Level	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test α = .05
High	MpS	6	7.500	2.645	4	21	
	Mp	3	7.000	1.414	4		
	SpS	4	7.250	1.258	4		
	Sp	1	5.750	.957	4		
	PrS	7	7.750	.957	4		
	Pr	2	7.000	.816	4		
	S	5	7.500	.291	4		
Medium	MpS	7	8.500	1.914	4	21	MpS > Pr
	Mp	5	7.500	0.577	4		
	SpS	4	7.500	0.577	4		
	Sp	2	6.500	1.000	4		
	PrS	3	6.750	1.707	4		
	Pr	1	6.250	0.957	4		
	S	6	8.250	1.258	4		
Low	MpS	7	8.000	0.816	4	21	
	Mp	4	7.000	1.414	4		
	SpS	5	7.250	0.500	4		
	Sp	3	7.000	1.633	4		
	PrS	2	7.000	--	4		
	Pr	6	7.750	1.258	4		
	S	1	7.000	0.816	4		

COMPARISON OF PRESENTATION MODE MEANS FOR HIGH, MEDIUM AND LOW MENTAL ABILITIES FOR THE APPLICATION OBJECTIVE

(Irrigation)

M.A. Level	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test α = .05
High	MpS	6	15.250	1.893	4	22	
	Mp	7	15.750	2.061	4		
	SpS	4	13.500	3.316	4		
	Sp	3	13.250	2.061	4		
	PrS	2	13.000	3.464	4		
	Pr	5	15.250	1.707	4		
	S	1	13.000	1.414	5		
Medium	MpS	5	11.750	3.201	4	24	
	Mp	7	15.000	3.109	7		
	SpS	4	11.500	5.196	4		
	Sp	3	11.250	2.872	4		
	PrS	2	11.250	2.630	4		
	Pr	1	10.500	2.380	4		
	S	6	12.000	2.943	4		
Low	MpS	7	14.500	3.109	4	21	
	Mp	4	12.250	1.893	4		
	SpS	6	13.750	4.500	4		
	Sp	2	10.750	2.061	4		
	PrS	3	11.250	1.707	4		
	Pr	1	10.750	2.872	4		
	S	5	13.000	4.320	4		

COMPARISON OF PRESENTATION MODE MEANS FOR HIGH, MEDIUM AND LOW MENTAL
ABILITIES FOR THE APPLICATION OBJECTIVE
(India)

M.A. Level	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
High	MpS	4	6.000	0.816	4	22	Sp > Pr
	Mp	3	5.500	1.224	6		
	SpS	5	6.250	0.957	4		
	Sp	7	6.750	1.707	4		
	PrS	6	6.333	2.081	3		
	Pr	1	4.500	1.291	4		
	S	2	5.000	1.414	4		
Medium	MpS	3	5.333	1.751	6	27	
	Mp	5	6.333	1.366	6		
	SpS	1	4.833	1.834	6		
	Sp	4	6.000	1.154	4		
	PrS	7	7.000	1.414	4		
	Pr	2	5.000	3.366	4		
	S	6	6.750	2.217	4		
Low	MpS	4	5.857	1.069	7	27	
	Mp	3	5.833	2.401	6		
	SpS	5	6.286	0.951	7		
	Sp	6	6.667	0.577	3		
	PrS	2	5.667	2.081	3		
	Pr	1	4.500	1.914	4		
	S	7	7.000	1.414	4		

COMPARISON OF PRESENTATION MODE MEANS FOR HIGH, MEDIUM AND LOW MENTAL ABILITIES FOR THE APPLICATION OBJECTIVE
(Labor)

M.A. Level	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
High	MpS	5	7.000	0.816	4	21	S > Mp Pr > PrS/Sp/Mp
	Mp	1	5.500	1.732	4		
	SpS	4	7.000	0.816	4		
	Sp	2	6.250	1.500	4		
	PrS	3	6.500	1.914	4		
	Pr	7	8.750	1.258	4		
	S	6	8.000	1.154	4		
Medium	MpS	3	6.500	1.732	4	21	S > Sp
	Mp	2	6.250	0.957	4		
	SpS	5	7.000	--	4		
	Sp	1	5.750	1.707	4		
	PrS	4	7.000	0.816	4		
	Pr	6	7.500	1.291	4		
	S	7	8.250	1.707	4		
Low	MpS	1	6.000	1.154	4	21	
	Mp	5	7.250	2.217	4		
	SpS	3	6.500	0.577	4		
	Sp	2	6.500	1.291	4		
	PrS	7	7.750	1.707	4		
	Pr	4	6.750	1.893	4		
	S	6	7.500	2.380	4		

COMPARISON OF PRESENTATION MODE MEANS FOR HIGH, MEDIUM AND LOW MENTAL ABILITIES FOR THE APPLICATION OBJECTIVE

(Heat)

M.A. Level	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
High	MpS	3	5.500	1.732	4	22	
	Mp	4	6.200	1.923	5		
	SpS	2	5.250	2.217	4		
	Sp	5	6.500	3.511	4		
	PrS	1	4.500	1.000	4		
	Pr	7	7.000	1.414	4		
	S	6	7.000	2.160	4		
Medium	MpS	7	7.500	1.000	4	22	
	Mp	2	6.000	2.449	4		
	SpS	6	7.250	2.061	4		
	Sp	1	6.000	3.266	4		
	PrS	3	6.200	1.095	5		
	Pr	4	6.750	0.500	4		
	S	5	7.250	2.753	4		
Low	MpS	2	5.000	1.414	4	20	S > Pr/MpS/SpS
	Mp	5	6.750	2.061	4		
	SpS	1	4.500	0.577	4		
	Sp	4	6.667	2.309	3		
	PrS	6	7.000	2.449	4		
	Pr	3	5.250	1.893	4		
	S	7	9.500	1.000	4		

COMPARISON OF PRESENTATION MODE MEANS FOR HIGH, MEDIUM AND LOW MENTAL ABILITIES FOR THE APPLICATION OBJECTIVE
(Salamanders)

M.A. Level	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
High	MpS	7	9.250	2.217	4	21	
	Mp	2	6.000	2.160	4		
	SpS	4	7.750	1.707	4		
	Sp	1	6.000	3.000	3		
	PrS	3	7.750	1.707	4		
	Pr	6	9.000	2.000	5		
	S	5	8.000	1.414	4		
Medium	MpS	6	8.500	2.516	4	19	Pr > Mp/PrS/S
	Mp	3	7.500	2.380	4		
	SpS	5	8.250	1.500	4		
	Sp	4	7.667	2.081	3		
	PrS	2	7.333	1.154	3		
	Pr	7	10.500	1.000	4		
	S	1	7.000	1.414	4		
Low	MpS	1	6.750	0.957	4	20	
	Mp	2	7.500	1.732	4		
	SpS	4	7.750	1.893	4		
	Sp	6	8.000	1.633	4		
	PrS	7	9.000	1.825	4		
	Pr	5	8.000	2.000	3		
	S	3	7.750	0.957	4		

COMPARISON OF PRESENTATION MODE MEANS FOR HIGH, MEDIUM AND LOW MENTAL ABILITIES FOR THE APPLICATION OBJECTIVE
(Mountains)

M.A. Level	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
High	MpS	6	13.750	0.957	4	22	
	Mp	3	12.500	2.380	4		
	SpS	7	14.333	2.081	3		
	Sp	4	12.750	3.947	4		
	PrS	1	11.500	2.645	4		
	Pr	2	12.500	1.760	6		
	S	5	13.750	0.957	4		
Medium	MpS	5	11.500	1.291	4	25	
	Mp	6	11.600	3.049	5		
	SpS	7	12.500	1.732	4		
	Sp	4	11.500	2.380	4		
	PrS	1	10.250	2.872	4		
	Pr	2	11.167	2.137	6		
	S	3	11.200	1.923	5		
Low	MpS	4	11.167	1.472	6	30	
	Mp	3	10.800	3.898	5		
	SpS	6	11.667	2.338	6		
	Sp	1	9.750	1.707	4		
	PrS	5	11.500	2.516	4		
	Pr	7	12.333	1.633	6		
	S	2	10.667	2.160	6		

COMPARISON OF PRESENTATION MODE MEANS FOR HIGH, MEDIUM AND LOW MENTAL ABILITIES FOR THE GENERALIZATION OBJECTIVE
(Thailand)

M.A. Level	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
High	MpS	4	8.500	1.291	4	21	
	Mp	1	7.500	0.577	4		
	SpS	7	9.250	1.258	4		
	Sp	5	8.750	2.500	4		
	PrS	3	8.250	1.707	4		
	Pr	2	8.250	2.217	4		
	S	6	9.000	1.633	4		
Medium	MpS	5	8.250	1.258	4	21	
	Mp	6	8.500	2.645	4		
	SpS	4	8.000	--	4		
	Sp	3	8.000	1.414	4		
	PrS	2	8.000	0.816	4		
	Pr	1	6.750	1.500	4		
	S	7	9.000	2.160	4		
Low	MpS	2	7.500	1.914	4	21	
	Mp	6	8.250	1.500	4		
	SpS	7	8.500	1.732	4		
	Sp	1	7.250	0.500	4		
	PrS	4	7.750	1.707	4		
	Pr	5	8.000	0.816	4		
	S	3	7.750	0.957	4		

COMPARISON OF PRESENTATION MODE MEANS FOR HIGH, MEDIUM AND LOW MENTAL ABILITIES FOR THE GENERALIZATION OBJECTIVE
(Irrigation)

M.A. Level	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
High	MpS	4	15.000	1.414	4	22	
	Mp	5	15.750	3.403	4		
	SpS	3	15.000	2.943	4		
	Sp	2	15.000	1.414	4		
	PrS	7	17.000	2.160	4		
	Pr	6	16.750	2.362	4		
	S	1	14.200	3.114	5		
Medium	MpS	7	14.500	3.000	4	24	
	Mp	4	14.000	2.708	7		
	SpS	6	14.500	2.645	4		
	Sp	5	14.250	1.500	4		
	PrS	3	12.750	3.304	4		
	Pr	1	11.250	1.707	4		
	S	2	11.750	1.500	4		
Low	MpS	7	14.500	1.732	4	21	MpS/Mp/SpS/PrS/ Sp > Pr
	Mp	6	14.500	2.516	4		
	SpS	5	14.500	2.081	4		
	Sp	3	14.250	0.500	4		
	PrS	4	14.500	1.914	4		
	Pr	1	11.000	2.582	4		
	S	2	11.500	2.081	4		

COMPARISON OF PRESENTATION MODE MEANS FOR HIGH, MEDIUM AND LOW MENTAL ABILITIES FOR THE GENERALIZATION OBJECTIVE
(India)

M.A. Level	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
High	MpS	7	8.750	2.217	4	22	MpS > S
	Mp	5	7.333	2.065	6		
	SpS	4	7.250	0.500	4		
	Sp	2	6.250	1.500	4		
	PrS	6	8.000	2.000	3		
	Pr	3	7.250	0.957	4		
	S	1	5.500	1.914	4		
Medium	MpS	3	7.000	1.673	6	27	
	Mp	5	7.333	0.816	6		
	SpS	7	7.500	2.073	6		
	Sp	1	5.500	1.732	4		
	PrS	6	7.500	1.914	4		
	Pr	4	7.250	2.630	4		
	S	2	6.500	1.000	4		
Low	MpS	4	6.714	1.253	7	27	
	Mp	5	7.167	1.169	6		
	SpS	6	7.286	2.138	7		
	Sp	3	5.667	1.527	3		
	PrS	7	7.333	1.154	3		
	Pr	2	5.500	1.000	4		
	S	1	5.500	2.380	4		

COMPARISON OF PRESENTATION MODE MEANS FOR HIGH, MEDIUM AND LOW MENTAL ABILITIES FOR THE GENERALIZATION OBJECTIVE
(Labor)

M.A. Level	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
High	MpS	7	9.500	1.000	4	21	
	Mp	3	9.000	2.449	4		
	SpS	1	8.250	1.500	4		
	Sp	2	9.000	--	4		
	PrS	6	9.500	0.577	4		
	Pr	5	9.500	1.732	4		
	S	4	9.500	1.732	4		
Medium	MpS	5	8.500	1.732	4	21	
	Mp	3	7.750	1.258	4		
	SpS	6	8.750	1.258	4		
	Sp	2	7.750	2.500	4		
	PrS	7	9.000	0.816	4		
	Pr	1	7.000	3.464	4		
	S	4	8.250	2.362	4		
Low	MpS	6	8.250	0.500	4	21	
	Mp	3	7.000	2.309	4		
	SpS	2	7.000	1.825	4		
	Sp	5	7.250	2.500	4		
	PrS	1	7.000	1.414	4		
	Pr	7	9.250	1.893	4		
	S	4	7.250	1.707	4		

COMPARISON OF PRESENTATION MODE MEANS FOR HIGH, MEDIUM AND LOW MENTAL ABILITIES FOR THE GENERALIZATION OBJECTIVE
(Heat)

M.A. Level	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
High	MpS	6	8.250	2.061	4	22	
	Mp	5	8.200	0.836	5		
	SpS	3	6.750	3.304	4		
	Sp	2	6.500	1.732	4		
	PrS	7	8.500	3.316	4		
	Pr	1	6.250	0.500	4		
	S	4	7.500	2.380	4		
Medium	MpS	4	6.500	2.081	4	22	
	Mp	3	6.500	1.732	4		
	SpS	1	5.500	1.732	4		
	Sp	5	7.000	1.825	4		
	PrS	7	7.400	1.140	5		
	Pr	2	6.250	2.061	4		
	S	6	7.250	1.707	4		
Low	MpS	3	5.750	1.258	4	20	
	Mp	4	6.500	1.000	4		
	SpS	6	7.500	0.577	4		
	Sp	1	5.000	1.732	3		
	PrS	5	6.750	2.986	4		
	Pr	2	5.250	2.630	4		
	S	7	7.750	2.217	4		

COMPARISON OF PRESENTATION MODE MEANS FOR HIGH, MEDIUM AND LOW MENTAL ABILITIES FOR THE GENERALIZATION OBJECTIVE
(Salamanders)

M.A. Level	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
High	MpS	2	9.750	1.707	4	21	
	Mp	4	10.000	2.160	4		
	SpS	7	11.000	1.154	4		
	Sp	1	8.000	4.582	3		
	PrS	6	10.750	2.500	4		
	Pr	5	10.200	2.387	5		
	S	3	10.000	1.414	4		
Medium	MpS	4	10.750	2.872	4	19	
	Mp	2	10.250	2.872	4		
	SpS	6	11.250	0.957	4		
	Sp	1	10.000	3.605	3		
	PrS	3	10.667	2.081	3		
	Pr	5	11.000	1.633	4		
	S	7	12.000	2.309	4		
Low	MpS	5	11.250	0.500	4	20	
	Mp	4	10.750	1.707	4		
	SpS	3	10.500	1.291	4		
	Sp	2	9.500	1.000	4		
	PrS	6	11.500	1.000	4		
	Pr	7	12.000	2.645	3		
	S	1	9.500	2.380	4		

COMPARISON OF PRESENTATION MODE MEANS FOR HIGH, MEDIUM AND LOW MENTAL ABILITIES FOR THE GENERALIZATION OBJECTIVE
(Mountains)

M.A. Level	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
High	MpS	6	13.500	2.380	4	22	Mp > S
	Mp	7	15.000	1.414	4		
	SpS	5	13.333	2.081	3		
	Sp	3	13.000	0.816	4		
	PrS	2	12.500	2.380	4		
	Pr	4	13.167	1.329	6		
	S	1	10.750	1.500	4		
Medium	MpS	5	12.500	0.577	4	25	
	Mp	4	12.400	1.673	5		
	SpS	7	14.000	2.000	4		
	Sp	3	12.250	1.893	4		
	PrS	2	11.500	2.081	4		
	Pr	6	13.167	1.722	6		
	S	1	11.200	2.490	5		
Low	MpS	3	11.000	2.190	6	30	
	Mp	6	11.400	1.140	5		
	SpS	7	12.000	3.741	6		
	Sp	1	9.750	0.957	4		
	PrS	2	10.500	1.914	4		
	Pr	5	11.333	1.751	6		
	S	4	11.167	3.311	6		

COMPARISON OF PRESENTATION MODE MEANS FOR HIGH, MEDIUM AND LOW MENTAL ABILITIES FOR THE CLASSIFICATION OBJECTIVE (Thailand)

M.A. Level	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
High	MpS	7	15.500	2.645	4	21	
	Mp	3	13.500	1.732	4		
	SpS	6	15.250	1.500	4		
	Sp	2	13.250	1.258	4		
	PrS	5	14.500	0.577	4		
	Pr	4	13.750	2.217	4		
	S	1	13.000	2.160	4		
Medium	MpS	5	13.000	2.160	4	21	
	Mp	7	13.500	1.914	4		
	SpS	6	13.500	1.000	4		
	Sp	3	12.250	1.500	4		
	PrS	4	13.000	3.915	4		
	Pr	1	11.250	1.707	4		
	S	2	12.250	2.872	4		
Low	MpS	5	12.750	2.753	4	21	
	Mp	7	14.000	1.414	4		
	SpS	3	12.000	0.816	4		
	Sp	2	10.500	2.516	4		
	PrS	6	13.000	4.761	4		
	Pr	1	10.500	1.732	4		
	S	4	12.750	1.500	4		

COMPARISON OF PRESENTATION MODE MEANS FOR HIGH, MEDIUM AND LOW MENTAL ABILITIES FOR THE CLASSIFICATION OBJECTIVE
(Irrigation)

M.A. Level	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test α = .05
High	MpS	6	5.500	0.577	4	22	
	Mp	5	5.500	1.732	4		
	SpS	4	5.250	3.201	4		
	Sp	2	4.250	2.061	4		
	PrS	1	3.750	1.893	4		
	Pr	7	6.250	0.500	4		
	S	3	4.400	2.073	5		
Medium	MpS	6	4.750	1.258	4	24	
	Mp	4	4.571	1.718	7		
	SpS	5	4.750	1.893	4		
	Sp	1	3.750	1.707	4		
	PrS	7	5.500	1.732	4		
	Pr	3	4.000	1.414	4		
	S	2	4.000	1.414	4		
Low	MpS	6	4.750	0.500	4	21	
	Mp	7	5.250	1.707	4		
	SpS	5	4.750	0.957	4		
	Sp	1	3.500	1.291	4		
	PrS	3	4.250	2.061	4		
	Pr	4	4.750	1.707	4		
	S	2	4.000	1.633	4		

COMPARISON OF PRESENTATION MODE MEANS FOR HIGH, MEDIUM AND LOW MENTAL ABILITIES FOR THE CLASSIFICATION OBJECTIVE
(India)

M.A. Level	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
High	MpS	5	11.750	2.872	4	22	SpS > Sp
	Mp	3	10.667	2.943	6		
	SpS	7	13.000	2.000	4		
	Sp	1	8.750	2.630	4		
	PrS	2	10.667	1.155	3		
	Pr	6	12.500	2.082	4		
	S	4	11.000	1.633	4		
Medium	MpS	6	11.000	1.788	6	27	
	Mp	4	10.667	4.131	6		
	SpS	7	12.167	2.401	6		
	Sp	2	9.750	3.201	4		
	PrS	1	9.250	0.957	4		
	Pr	3	10.000	1.633	4		
	S	5	11.000	2.449	4		
Low	MpS	7	11.429	2.299	7	27	
	Mp	3	10.833	2.137	6		
	SpS	5	11.286	1.253	7		
	Sp	2	10.667	2.516	3		
	PrS	6	11.333	1.527	3		
	Pr	1	9.500	1.291	4		
	S	4	11.000	0.816	4		

COMPARISON OF PRESENTATION MODE MEANS FOR HIGH, MEDIUM AND LOW MENTAL ABILITIES FOR THE CLASSIFICATION OBJECTIVE
(Labor)

M.A. Level	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
High	MpS	7	12.750	0.957	4	21	
	Mp	2	10.000	2.943	4		
	SpS	5	10.250	2.500	4		
	Sp	4	10.250	1.258	4		
	PrS	1	9.750	1.500	4		
	Pr	3	10.250	1.893	4		
	S	6	11.000	2.449	4		
Medium	MpS	5	10.250	2.217	4	21	PrS/SpS > S/Sp
	Mp	4	10.250	0.957	4		
	SpS	6	12.500	1.000	4		
	Sp	1	8.250	2.061	4		
	PrS	7	12.750	1.258	4		
	Pr	3	10.250	0.957	4		
	S	2	9.000	3.162	4		
Low	MpS	7	12.500	1.000	4	21	MpS/SpS > Mp
	Mp	1	7.250	2.362	4		
	SpS	6	12.500	2.886	4		
	Sp	4	9.250	3.304	4		
	PrS	2	9.000	2.160	4		
	Pr	5	9.750	2.986	4		
	S	3	9.250	1.258	4		

COMPARISON OF PRESENTATION MODE MEANS FOR HIGH, MEDIUM AND LOW MENTAL ABILITIES FOR THE CLASSIFICATION OBJECTIVE
(Heat)

M.A. Level	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
High	MpS	7	16.250	1.258	4	22	SpS/Mp/SpS > PrS
	Mp	6	15.400	2.302	5		
	SpS	5	15.250	0.957	4		
	Sp	4	14.750	1.258	4		
	PrS	1	11.500	3.415	4		
	Pr	3	13.750	1.893	4		
	S	2	13.000	3.366	4		
Medium	MpS	1	12.000	3.559	4	22	
	Mp	6	13.500	1.291	4		
	SpS	7	15.500	1.825	4		
	Sp	3	13.000	3.366	4		
	PrS	5	13.400	2.074	5		
	Pr	2	12.500	1.000	4		
	S	4	13.250	2.872	4		
Low	MpS	4	13.250	2.061	4	20	MpS/S/PrS/SpS > Sp
	Mp	3	12.750	1.893	4		
	SpS	7	14.750	1.500	4		
	Sp	1	9.667	1.154	3		
	PrS	6	13.750	2.362	4		
	Pr	2	12.000	2.708	4		
	S	5	13.500	1.732	4		

COMPARISON OF PRESENTATION MODE MEANS FOR HIGH, MEDIUM AND LOW MENTAL ABILITIES FOR THE CLASSIFICATION OBJECTIVE

(Salamanders)

M.A. Level	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
High	MpS	2	4.000	1.414	4	21	SpS > PrS/MpS/S
	Mp	5	4.750	1.258	4		
	SpS	7	6.500	1.732	4		
	Sp	4	4.667	1.154	3		
	PrS	3	4.250	0.957	4		
	Pr	6	6.000	1.581	5		
	S	1	4.000	0.816	4		
Medium	MpS	7	5.750	1.258	4	19	
	Mp	4	4.500	1.291	4		
	SpS	6	5.500	2.081	4		
	Sp	2	3.000	2.645	3		
	PrS	5	5.000	2.000	3		
	Pr	1	3.000	0.816	4		
	S	3	3.250	1.500	4		
Low	MpS	6	4.750	3.304	4	20	
	Mp	3	3.750	1.500	4		
	SpS	7	5.000	1.825	4		
	Sp	4	4.000	2.160	4		
	PrS	2	3.500	1.291	4		
	Pr	5	4.333	1.154	3		
	S	1	3.500	1.291	4		

COMPARISON OF PRESENTATION MODE MEANS FOR HIGH, MEDIUM AND LOW MENTAL ABILITIES FOR THE CLASSIFICATION OBJECTIVE
(Mountains)

M.A. Level	Mode	Rank	$\overline{X}$	σ	No. of Rep.	df	Duncan Multiple Range Test $\alpha = .05$
High	MpS	7	6.750	0.500	4	22	
	Mp	5	6.250	0.957	4		
	SpS	3	6.000	1.000	3		
	Sp	2	6.000	1.154	4		
	PrS	4	6.250	1.500	4		
	Pr	1	5.833	1.472	6		
	S	6	6.500	1.291	4		
Medium	MpS	1	5.000	1.825	4	25	PrS > MpS
	Mp	2	5.600	1.140	5		
	SpS	5	6.250	0.957	4		
	Sp	4	6.250	0.957	4		
	PrS	7	7.000	0.816	4		
	Pr	3	6.000	1.264	6		
	S	6	6.600	0.894	5		
Low	MpS	5	5.667	1.633	6	30	Pr > S
	Mp	3	5.200	1.095	5		
	SpS	2	4.833	1.722	6		
	Sp	6	5.750	1.500	4		
	PrS	4	5.500	1.291	4		
	Pr	7	6.667	0.516	6		
	S	1	4.000	1.673	6		

APPENDIX C

SCRIPTS FOR PRESENTATION MODES

Floating Markets of Thailand

Much of Thailand is made up of canals and waterways. Some motor boats and many small paddle boats crowd the narrow waterways. Besides being used for transportation, the waterways serve as the main market places.

Women, in their paddle boats, bring loads of different kinds of fresh food to sell in the market.

The wooden docks along the waterways are crowded with women and children who have come to sell and shop. They buy several kinds of vegetables which are sold by weight. Fish also are sold. They are carefully weighed in a basket while the customer watches.

The docks are lined with baskets of farm products. Each merchant sells only one or two kinds of products. The waterways are so crowded there hardly seems room for any more boats, but somehow the skillful people paddle their boats along.

The small foot-bridges that cross the canals are favorite places to watch the activities of the busy market. The canals of Thailand are always filled with activities.

In some of the small boats lining the waterways, men cook chickens to sell. Other boats filled with farm products move about.

Along the sides of the canals, there are also many shops that sell colorful handkerchiefs and clothing. These are hung up along the canals in front of the small shops.

The crowded, floating markets of Thailand are rapidly changing scenes of activity.

Egyptian Irrigation

The Nile River is the Egyptian farmer's main source of water. The banks of the river are very sandy, and in some places very few plants grow. The fields are higher than the river, so the farmers use a number of tools to lift the water from the river to their fields.

One tool looks like a playground teeter-totter. A long pole is placed across the top of a post. A pail is tied with a rope to one end of the long pole. On the other end is a weighted basket. The worker empties the pail and pulls down on the rope to refill it. The weighted end then rises. When the pail is full, the weighted basket helps raise it.

Some farmers use heavy stones in place of the weighted basket. They fill the pail with water from the river. Then the heavy stone helps them lift the full pail up to the fields above. There the pail is emptied.

Another tool they use is a large wheel made of wood and rope. Many large clay jars are attached to the wheel. As the wheel turns, the jars scoop water from a ditch below. As the jars reach the top of the wheel, the water empties into another ditch at a higher level.

The wheel is turned by two oxen attached to the wheel through an arrangement of gears. A woman urges them on by hitting them with a stick. As the oxen walk in a circle, the water wheel slowly turns, and a steady flow of water pours from the jars.

Another tool the Egyptian farmer uses looks like a big hollow wooden pipe. Running through the pipe is something that looks like a large screw.

The bottom of the pipe is placed in a ditch below, and a crank is attached to the top end of the pipe. As the farmer turns the crank, the water is lifted from below along the screw and empties onto the field above.

The farmers control the flow of water through the fields by making or removing small dirt dams with hoes. Each plant is then watered by water flowing between the rows of plants. It takes several workers with hoes to control the water flowing through the fields.

Transportation in India

The people of India travel in many different ways. Trains are used to carry passengers and freight. In the cities, men pull carts loaded with freight.

Horse and ox-drawn carts move freight and people, while buses and trucks also move on the crowded streets. Some of the ox-drawn wooden carts use wheels from old trucks and cars.

In the city, a policeman, with a brightly colored hat, directs all of the different kinds of traffic. He must control the flow of cars, trucks, buses, motorcycles, bicycles, carts and pedestrians.

Driving a car in the city is quite difficult because of the many different things using the roads. Elephants also use the roads for carrying freight and people.

In the rural areas, donkeys can be seen carrying products to market. The mountain people often use sheep to carry small loads along the narrow trails.

In flat country areas, large wooden and cloth racks are attached to the backs of water buffalo to carry freight. Farm women lead the animals, while the men carry the small children.

Several hundred people can travel at one time on large ferry boats which share the rivers with large and small freight boats. At the seaports, camels are used to carry freight taken from large ocean going ships.

Eastern Europe

The farmers of Eastern Europe still do much of their work by hand. Women help plant fields as well as men.

Oxen are used to pull hand-made plows through the fields. Oxen are also used to pull drags made of logs across the rolling hills to make them level. Work horses are used in the fields to move wagons loaded with alfalfa, which is grown in large amounts. Tractors haul several wagons at a time, each loaded with animal food crops.

Water for the animals is obtained by scooping pails of water from wells. Women wash clothes in the rivers and spread them out on the banks to dry.

In the cities, women sweep streets while both men and women dig ditches. Large bulldozers, operated by men, are used on huge dam building projects. Street cleaning machines are also used to clean the main city streets. On other streets, women sweep them clean with brooms.

Building bricks are carried to the brick layers by men and women laborers. Home basements are dug by hand, and only simple machines are used for building.

At train crossings, for safety purposes, a man lowers a steel barrier with a crank to block the road. Hand tools are also used to strip the bark from logs.

In the factories, women pack and carry crates of goods. Men also unload products from trucks by hand. Women color, decorate and package Christmas tree ornaments without machines.

Men form clay flower pots on machines, while women inspect and add the finishing touches by hand. When the flower pots have been placed in wooden crates, men load the crates into trucks with the help of hand trucks.

At the seaports, large cranes are used to load and unload the sea-going ships.

Heat

A small amount of water in a test tube is heated over an electric heater plate. A rubber cork is placed half way down the neck of the test tube. As the water heats up, bubbles begin to form in the water.

The rubber cork, that was placed in the test tube, slowly begins to move toward the open end. Finally, when the work nears the end, it rapidly pops out.

Another example shows a bottle suspended from a wire. The bottle contains a small amount of water which is again heated.

The bottle has a cork in the top, plus two small open tubes coming out of the neck. The tubes are bent so that they point in opposite directions and let the steam from the boiling water escape. The bottle turns or rotates in the opposite direction to the escaping steam.

In a third example, a small amount of water in a bottle is again heated over an electric heater plate. This time, the bottle has one small tube passing through the cork in the top.

Steam escapes through this tube. The steam is pointed at the blades of several kinds of pin wheels. The pin wheels spin until they are removed from the path of the escaping steam.

Salamanders

This salamander, brown in color, is called a Newt salamander. It has a long tail and lives in or near shallow pools of water. It uses its four legs and tail to move along the bottom of ponds.

On land, it is found near damp rocks and moves very slowly, using only its legs. It is able to cling to the damp rocks because it has four toes on each of its feet. This salamander breathes through a nose with two tiny holes. Its two eyes bulge from the sides of its head. The skin of this salamander always looks wet.

The Tree salamander lives on land and is often found under pieces of loose bark on trees. This salamander also breathes through two tiny holes at the end of its nose. Two eyes bulge from the sides of its head.

Each of its two front feet have four toes. Its two back feet each have five toes. It uses its four legs to move slowly about and is also a very good climber. This salamander has tiny yellow spots on its blackish-brown body.

Another kind of salamander is the Mud Puppy which lives only in water. This salamander has two tiny eyes on the sides of its head. It moves about on the bottom of ponds by using its four legs and wiggling its body.

Two external gills are located behind its head. They look like small feathers waving in the water and enable it to breathe. The skin of this salamander is a dark gray with small yellow blotches.

A fourth kind of salamander is called a Siren. It has a long, thin, black body and lives only in water. It has only two small stubby legs located just behind the head. The legs can be used for moving along the bottom of ponds. But mainly it uses its long, thin body to wiggle through the water.

This salamander also has external gills which look like feathers sticking out of its body just behind its head. From a distance, it looks like a snake.

Dome and Volcanic Mountains

Some mountains are called dome mountains and look rough and rugged. They are formed when melted rock forces the surface of the earth upward. The melted rock stays below the surface, but the ground is pushed up. After many years, the smooth ground on a dome mountain is worn away.

Volcanic mountains are formed when melted rock is forced through cracks in the crust of the earth. The melted rock then piles up on the surface. The melted rock is sometimes thrown high into the air.

The melted rock, or lava, is a reddish-yellow liquid and is extremely hot. As the lava piles up, it begins to cool and turns hard and black.

Great amounts of smoke and steam escape from the mouth of the volcano with the melted rock.

Sometimes the opening in the top of a volcanic mountain is very far across. The flowing lava often looks like a big river.

APPENDIX D

PERFORMANCE TESTS

Thailand

1. Circle one or more of the things that are most like what you learned about Thailand. (Application)
   - a. a harbor in Alaska
   - b. a parking lot in a city
   - c. a coastal city on very low land
   - d. Olvera Street in Los Angeles
   - e. the freeway that goes through Bellflower
   - f. a school assembly
2. Circle one or more of the things that are most like the Thailand markets. (Application)
   - a. looking for something in a big crowd
   - b. a village market in Mexico
   - c. a supermarket in Bellflower
   - d. booths at a county fair
   - e. the food in a home refrigerator
3. Circle one or more things that describe the Thailand market place. (Generalization)
   - a. It is a place to buy food only.
   - b. Many merchants sold only one product.
   - c. Most of the food sold has come from a long distance away.
   - d. There is not much choice of what to buy.
   - e. It is a place where the entire family shops together.
   - f. Frozen foods are also sold here.

4. Circle one or more of the things that best describe what Thailand is like. (Generalization)

    a. The people live almost entirely on vegetables.

    b. There are many different travel vehicles.

    c. It has a hot and wet climate.

    d. It is difficult to be on time when traveling.

    e. It is a country with many iron mines.

    f. The people do not like to be in crowded places.

5. Circle one or more things that tell about the geography of Thailand. (Classification)

    a. fish, farm products, canals

    b. fish, merchants, weight

    c. children, merchants, women

    d. dress, bridges, wooden docks

6. Circle one or more things that best describe what people eat in Thailand. (Classification)

    a. fish, bread, carrots

    b. fruit, chickens, fish

    c. vegetables, fruit, fresh meat

    d. chicken, apples, bananas

7. From what you learned, circle one or more of the things that best describe what the people of Thailand are like. (Classification)

    a. merchants, farmers, fishermen

    b. merchants, salesmen, sailors

    c. painters, chicken-raisers, loggers

    d. housewives, fishermen, boat-repairmen

8. fish

clothing (Classification)

chicken

The above three things best belong to which one of the following choices?

a. sold by trading

b. sold by individual merchant

c. sold by the package

d. none of the above

9. vegetables (Classification)

chicken

fish

The above three things best belong to which one of the following choices?

a. sold by individual merchant

b. sold by the package

c. sold by trading

d. none of the above

10. fish (Classification)

chicken

gasoline

The above three things best belong to which one of the following choices?

a. sold by the package

b. sold by individual merchant

c. sold by trading

d. none of the above

11. clothing (Classification)

chickens

gasoline

The above three things best belong to which one of the following choices?

a. sold by trading

b. sold by individual merchant

c. sold by the package

d. none of the above

12. Circle the things that tell about how the people travel in Thailand. (Classification)

a. canal, bridge, road

b. bridge, canal, paddling

c. automobile, on foot, boat

d. on foot, by automobile, in boats

Irrigation

1. The water raising tool that used the crank and screw is most like which of the following things? (Circle one or more of the correct answers.)

   a. a man sawing a stick (Application)

   b. a man loading a truck

   c. a man turning on a water faucet

   d. a man drilling a hole in a board

   e. a man sharpening a pencil

   f. a man pouring water into a pipe

2. The water raising tool that used the pole and pail is most like which of the following things? (Circle one or more correct answers.) (Application)

   a. a man prying up a nail in a board with a hammer

   b. a man watering the yard

   c. a man rolling a barrel

   d. a man drinking through a straw

   e. a man loading a truck

   f. a man turning on a water faucet

3. The water raising method that used the water wheel is most like which of the following things? (Circle one or more correct answers.) (Application)

   a. delivering water by truck

   b. a boy pedalling a bicycle

   c. a man rowing a boat

   d. a ditch-digging machine

   e. the slide-paddle boat at Disneyland

   f. turning a pipe valve

4. Circle one or more of the following things that are most like the people you just learned about. (Application)

   a. tomato and orange pickers of California

   b. slave labor on a cotton plantation

   c. irrigation and farming in America today

   d. skills of American factory workers

   e. a person planting a small garden in the city

   f. fishermen along the beach

5. Circle one or more of the things that best describe the water wheel method. (Generalization)

   a. The flow of water to the fields is not even.

   b. It does not lift the water, but just makes it move faster.

   c. The water is used to do work.

   d. It gets the most water with the fewest workers.

   e. The power to run it is very simple.

   f. Non-human power can be used.

6. Circle one or more of the things that best describe the pole and pail method. (Generalization)

   a. It gives a very even flow of water.

   b. It shows how water is made to do work.

   c. It works on the idea of the lever.

   d. It is very simple to operate.

   e. A large amount of water can be lifted.

   f. It uses the forces of nature instead of manpower.

7. Circle one or more of the things that best describe the crank and screw method. (Generalization)

    a. It needs a skilled worker to run it.

    b. It shows how water is made to do work.

    c. It works like a teeter totter.

    d. It uses the same idea as a fishing reel.

    e. It shows a different use for a common tool.

    f. The flow of water is even.

8. Circle one or more of the things that are like the people and their work in Egypt. (Generalization)

    a. Most jobs were done with physical labor.

    b. The machinery used suited the kind of work to be done.

    c. Women do the same jobs as men.

    d. Egyptian tool use is about the same as that of an American farmer.

    e. There appears to be no electric power.

    f. Farm workers are skilled.

9. lifting (Classification)

even flow of water

one man

The above three things best belong to which one of the following choices?

    a. the pole and pail method

    b. crank and screw method

    c. water wheel method

    d. none of the above

10. container (Classification)

stone

rope

The above three things best belong to which one of the following choices?

a. water wheel method

b. crank and screw method

c. pole and pail method

d. none of the above

11. animal (Classification)

containers

gears

The above three things best belong to which one of the following choices?

a. crank and screw method

b. water wheel method

c. pole and pail method

d. none of the above

12. Circle one or more of the things that describe the people and their work. (Classification)

a. simple tools, work in fields, make tools

b. homemade tools, manual labor, work in fields

c. electric power, water is hard to get, people work hard

d. hoe fields, work easy to learn, men and women work

e. tools run by people, heavy rainfall, water is important

f. simple work, machines, grow food

India

1. Circle one or more of the best things that are like the transportation in India. (Application)

    a. the assembly line in an auto factory

    b. driving home from work at 5 o'clock

    c. a museum exhibit showing all kinds of ways people travel

    d. a person who is never on time

    e. a town in the jungles of Africa

    f. a school playground

2. Circle one or more of the best things that are like travel in India. (Application)

    a. using a computer to solve problems

    b. making tea in a coffee pot

    c. using skis on the snow

    d. staying in the room during a fire drill

    e. putting chains on your tires in the snow

    f. eating breakfast in the morning and supper at night

3. Circle one or more of the things that tell what travel is like in India. (Generalization)

    a. Freight moves only by animals.

    b. People travel mostly on animals.

    c. It is easy to move from place to place.

    d. Ways of travel are changing.

    e. In the city traffic is controlled in some way.

    f. You need a bike to travel in the city.

4. Circle one or more of the things that would tell you which part in India you might be in.

(Generalization)

- a. the kinds of freight the animals carried
- b. whether or not there is a policeman
- c. the way people passed each other on the road
- d. the kinds of vehicles seen
- e. amount of freight carried
- f. whether or not people walked
- g. whether or not animals were used

5. freight boats (Classification)

cranes

camel

The above three things best belong to which one of the following choices?

- a. mountain travel
- b. city travel
- c. travel in the countryside
- d. river-seaport areas
- e. none of the above

6. oxen (Classification)

carts

bicycles

The above three things best belong to which one of the following choices?

- a. city travel
- b. travel in the countryside
- c. mountain travel
- d. river-seaport travel
- e. none of the above

7. donkeys (Classification)

walking

elephants

The above three things best belong to which one of the following choices?

a. river-seaport areas
b. city travel
c. travel in the countryside
d. mountain travel
e. none of the above

8. buses (Classification)

bicycles

animals

The above three things best belong to which one of the following choices?

a. travel in the countryside
b. city travel
c. mountain travel
d. river-seaport travel
e. none of the above

9. sheep (Classification)

trails

small freight

The above three things best belong to which one of the following choices?

a. city travel
b. mountain travel
c. travel in the countryside
d. river-seaport areas
e. none of the above

10. buffalo (Classification)

people walking

children carried

The above three things best belong to which one of the following choices?

a. city travel
b. mountain travel
c. river-seaport travel
d. travel in the countryside
e. none of the above

11. Circle one or more groups of things that show the problems of travel in India. (Classification)

a. boats, donkeys, elephants
b. policemen, sheep, large loads
c. animals on road, speed of trucks, condition of road
d. traffic jams, speed of trucks, many bicycles

12. Circle one or more groups of things that tell travel is changing. (Classification)

a. rough roads, sheep trails, mountains
b. buses, bicycles, ships
c. buffalo, trucks, traffic jams
d. donkeys, camels, elephants

13. Circle one or more groups of things that had to do with the moving of freight. (Classification)

a. boat, auto, camel
b. elephant, camel, boat
c. sheep, cart, boat
d. train, bicycle, cart
e. camel, buffalo, donkey

Labor

1. Circle one or more of the things most like the way of life in Eastern Europe. (Application)
    - a. life on a cotton plantation
    - b. a junk yard with many old autos
    - c. city with many appliance repair shops
    - d. a country with both cities and farms
    - e. life in Canadian cities
    - f. jobs women do in America
2. Circle one or more of the things most like the work in Eastern Europe. (Application)
    - a. grape and orange pickers in California
    - b. picking cotton by machine
    - c. jobs done by workers in a cafeteria
    - d. jobs women do in America
    - e. camels carrying loads across the desert
    - f. assembly workers in a factory
3. Circle one or more of the things you learned about that describe work in Eastern Europe. (Generalization)
    - a. Work is done quickly.
    - b. Most jobs are done by physical labor.
    - c. Almost all the jobs are done by men.
    - d. Animals and machines often do the same kinds of work.
    - e. There are more skilled than unskilled workers.
    - f. People and machines often do the same kind of work.

4. Circle one or more of the things you learned about that describe what Eastern Europe is like.

(Generalization)

   a. Country roads are in good condition.

   b. People enjoy much recreation.

   c. Many people work on building projects.

   d. Farms employ many machine operators.

   e. The country is moving toward modernization.

   f. The country depends more upon machines than upon human labor.

5. (Classification)

street cleaners

ditch diggers

factory workers

The above three things best belong to which one of the following choices?

   a. life in the countryside

   b. city life

   c. seaport life

   d. none of the above

6. (Classification)

men and women working

machines

animals

The above three things best belong to which one of the following choices?

   a. city life

   b. seaport life

   c. life in the countryside

   d. none of the above

7. *cheap labor* (Classification)

use of machines

good roads

The above three things *best* belong to which *one* of the following choices?

a. life in the countryside

b. seaport life

c. city life

d. none of the above

8. *crane* (Classification)

boat

freight

The above three things *best* belong to which *one* of the following choices?

a. seaport life

b. city life

c. life in the countryside

d. none of the above

9. *pails of water* (Classification)

drying clothes

leveling land

The above three things *best* belong to which *one* of the following choices?

a. life in the countryside

b. seaport life

c. city life

d. none of the above

10. loading trucks (Classification)

building houses

making pots

The above three things best belong to which one of the following choices?

a. life in the countryside

b. seaport life

c. city life

d. none of the above

11. washing clothes (Classification)

cleaning streets

raising train crossing gate

The above three things best belong to which one of the following choices?

a. human power

b. animal power

c. machine power

d. none of the above

12. plowing fields (Classification)

inspecting clay pots

washing clothes

The above three things best belong to which one of the following choices?

a. animal power

b. human power

c. machine power

d. none of the above

13. cleaning streets (Classification)

making ditches

seeding fields

The above three things best belong to which one of the following choices?

a. machine power

b. animal power

c. human power

d. none of the above

14. ship loading (Classification)

building dams

hauling hay

The above three things best belong to which one of the following choices?

a. animal power

b. machine power

c. human power

d. none of the above

15. making fields ready (Classification)

hauling hay

plowing

The above three things best belong to which one of the following choices?

a. human power

b. animal power

c. machine power

d. none of the above

16. digging ditches (Classification)

driving bulldozers

train crossing guard

The above three things best belong to which one of the following choices?

a. women's work

b. both men's and women's work

c. men's work

d. none of the above

17. cleaning streets (Classification)

digging ditches

carrying bricks

The above three things best belong to which one of the following choices?

a. men's work

b. women's work

c. both men's and women's work

d. none of the above

18. crossing guard (Classification)

bricklayer

bulldozers

The above three things best belong to which one of the following choices?

a. both men's and women's work

b. men's work

c. women's work

d. none of the above

19. cleaning streets (Classification)

loading ships

stripping logs

The above three things best belong to which one of the following choices?

a. women's work

b. men's work

c. both men's and women's work

d. none of the above

20. inspecting pots (Classification)

painting ornaments

digging ditches

The above three things best belong to which one of the following choices?

a. both men's and women's work

b. women's work

c. men's work

d. none of the above

21. planting fields (Classification)

sweeping streets

inspecting pots

The above three things best belong to which one of the following choices?

a. women's work

b. men's work

c. both men's and women's work

d. none of the above

Heat

1. Circle one or more of the ways that things move that are most like what you just learned. (Application)

   a. drilling a hole

   b. looking through a telescope

   c. baking a cake

   d. drawing a circle

   e. throwing a stone

   f. filling a glass with water

2. Circle one or more of the things that are most like the way things were done. (Application)

   a. pushing a lawn mower

   b. reading a book on science

   c. riding a bicycle

   d. cooking a meal

   e. rowing a boat

   f. watching a TV program

3. Circle one or more of the things that describe what you learned about. (Generalization)

   a. For every action there is a reaction.

   b. The power for the experiments was the water.

   c. The glass tubes do work.

   d. Steam makes heat.

   e. Steam pulls things.

   f. Steam and heat do the same things.

4. Circle one or more of the things that describe the things you learned about. (Generalization)

   a. Steam and heat were the same.

   b. More water will cause more pressure.

   c. Steam puts forth more pressure than does water.

   d. Steam can move things in any direction.

   e. Steam takes up the same amount of space as water.

   f. Pressure is the same as steam.

5. From what you learned, circle one or more of the following that describe the idea of expansion. (Classification)

   a. a cork moving in the test tube

   b. small tubes on bottle

   c. a bottle going around

   d. steam causing bottle to move

   e. bubbles forming in the water

   f. pin wheel going around

6. From what you learned, circle one or more of the things that describe the idea of work being done. (Classification)

   a. the bottle turning because the steam was escaping

   b. pressure moving the cork

   c. test tube in the clamps

   d. the cork in the test tube

   e. bottle sitting on electric plate

   f. steam hitting the fan

   g. the hollow tubes of the bottle

7. From what you learned, circle one or more of the following that describe the idea of pressure.

(Classification)

a. water boiling

b. starting the heater plate

c. pulling

d. effect of steam escaping

e. what steam does to the work in the test tube

f. steam going through the air

g. putting the water in the bottle

8. Circle one or more of the things that are correct for the pin wheel and the hanging bottle experiments.

(Classification)

a. Corks were in the same place in both.

b. Steam was present in both.

c. Both used wire.

d. Bottles turned in both.

e. More water was needed in the pin wheel than in the hanging bottle experiment.

f. Heat was used in both.

Salamanders

1. The physical appearance of salamanders is most like which of the following? (Circle one or more correct answers.) (Application)

    a. a fish

    b. a dog

    c. a game of crack-the-whip

    d. a boy just out of a shower

    e. a spider

    f. a soldier crawling

2. The ways that salamanders move are most like which one of the following? (Circle one or more correct answers.) (Application)

    a. playing hopscotch

    b. riding in a car

    c. riding a skate board

    d. an airplane taking off

    e. writing a letter

    f. operating a bicycle

3. The living habits of salamanders are most like which of the following? (Circle one or more correct answers.) (Application)

    a. putting water into an aquarium

    b. choosing which pans to use in cooking a meal

    c. using different kinds of dog food

    d. finding a shady place

    e. feeding a bird

    f. building houses for different families

4. Salamanders look like which of the following things? (Circle one or more correct answers.)

(Generalization)

   a. They all need air to breathe.
   b. They each breathe in a different kind of way.
   c. Different salamanders have different kinds of eyes.
   d. They all have the same number of toes on their front feet.
   e. Their bodies all look very similar.
   f. They are four different colors.

5. Salamanders move around in which of the following ways? (Circle one or more correct answers.)

(Generalization)

   a. They all use their legs to help them move.
   b. They all wiggle their bodies to help them move.
   c. They all use their tails to help them move.
   d. The way they move is decided by how long they are.
   e. They move in any direction.
   f. They usually move slowly.

6. Salamanders have which of the following kinds of living habits? (Circle one or more correct answers.)

(Generalization)

   a. They can all live either in water or on land.
   b. For the most part, they get their food on the land.
   c. Salamanders are hard to find.
   d. Salamanders would usually be found in wet and damp places.
   e. They usually swim on the surface of ponds.
   f. Sometimes salamanders are found in open fields.

7. gills (Classification)

snake-like body

small eyes

The above three things best belong to which one of the following choices?

a. salamanders living on land

b. salamanders living in water

c. salamanders living on land and in water

d. none of the above

8. four toes (Classification)

five toes

no tail

The above three things best belong to which one of the following choices?

a. salamanders living on land and in water

b. salamanders living on land

c. salamanders living in water

d. none of the above

9. four legs (Classification)

spots on body

holes for breathing

The above three things best belong to which one of the following choices?

a. salamanders living on land

b. salamanders living on land and in water

c. salamanders living in water

d. none of the above

10. external gills (Classification)

gray skin

four legs

The above three things best belong to which one of the following choices?

a. newt salamander
b. tree salamander
c. mud puppy salamander
d. siren salamander
e. none of the above

11. swimming (Classification)

dark gray

four legs

The above three things best belong to which one of the following choices?

a. newt salamander
b. mud puppy salamander
c. siren salamander
d. tree salamander
e. all of the above

12. lives in water and on land (Classification)

holes in nose

four legs

The above three things best belong to which one of the following choices?

a. newt salamander
b. tree salamander
c. mud puppy salamander
d. siren salamander
e. none of the above

13. spots on skin (Classification)

climber

lives on land

The above three things best belong to which one of the following choices?

a. newt salamander
b. tree salamander
c. mud puppy salamander
d. siren salamander
e. all of the above

14. snake-like (Classification)

two legs

small eyes

The above three things best belong to which one of the following choices?

a. newt salamander
b. mud puppy salamander
c. siren salamander
d. tree salamander
e. all of the above

15. walking (Classification)

swimming

four legs

The above three things best belong to which one of the following choices?

a. mud puppy salamander
b. tree salamander
c. newt salamander
d. siren salamander
e. all of the above

Mountains

1. The formation of a volcanic mountain is most like which of the following things? (Circle one or more correct answers.) (Application)

   a. putting air into a balloon

   b. ants making an anthill

   c. mining for gold in a mine

   d. building a pyramid

   e. a broken fire hydrant

   f. squeezing toothpaste out of a tube

2. The action of molten lava is most like which of these things? (Circle one oe more correct answers.) (Application)

   a. oatmeal cooking in a pan

   b. baking a cake

   c. melting ice cream

   d. cleaning up after a flood

   e. making a concrete driveway

   f. plowing a field

3. The formation of a dome mountain is most like which of the following things? (Circle one or more correct answers.) (Application)

   a. a tire blowing out

   b. a broken water main

   c. blowing soap bubbles with a toy pipe

   d. opening an umbrella

   e. dumping a load of gravel in a driveway

   f. drilling an oil well

4. Circle one or more of the things that tell what a volcanic mountain is like. (Generalization)

   a. uneven and jagged

   b. looks like sharp, broken stone

   c. pressure moving ground but not breaking it

   d. an earthquake

   e. a rounded hill

   f. a water well

5. Circle one or more of the things that tell what a dome mountain is like. (Generalization)

   a. a crack in the top of the ground

   b. a result of molten rock under the ground

   c. a round pile of lava

   d. a bulge on the earth's surface

   e. remains of an explosion

   f. pressure moving earth's layers without breaking them

6. Circle one or more of the answers that are correct about molten lava. (Generalization)

   a. formed deep in the earth

   b. forms black rock when it cools

   c. melted iron and copper

   d. resists heat

   e. rock that is burned up and destroyed by a fire

   f. color depends on temperature

7. melted rock underground (Classification)

round

smooth

The above three things best belong to which one of the following choices?

a. volcanic mountain

b. molten lava

c. dome mountain

d. none of the above

8. black (Classification)

sharp

hard

The above three things best belong to which one of the following choices?

a. dome mountain

b. volcanic mountain

c. molten lava

d. none of the above

9. lava rocks (Classification)

smoke

steam

The above three things best belong to which one of the following choices?

a. molten lava

b. dome mountain

c. volcanic mountain

d. none of the above

10. steep sides (Classification)

jagged rocks

open top

The above three things best belong to which one of the following choices?

a. dome mountain

b. molten lava

c. volcanic mountain

d. none of the above

11. reddish yellow (Classification)

hot

liquid

The above three things best belong to which one of the following choices?

a. dome mountain

b. volcanic mountain

c. molten lava

d. none of the above